British Columbia
Geological Survey Branch

Style Guide

by Brian Grant
John M. Newell

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

Information Circular 1992-7

Province of British Columbia
Ministry of Energy, Mines
and Petroleum Resources

Mineral Resources Division
Geological Survey Branch

British Columbia
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STYLE GUIDE

By B. Grant and J.M. Newell

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FOREWORD

The publications of the British Columbia Geological Survey Branch reflect a wealth of tradition, scientific creativity and good grammar. That these elements are not always suitably balanced in potential authors gives rise to the need for editors, and guidelines for the preparation and presentation of geoscience research results.

The mandate of the Geological Survey Branch includes the timely delivery of geoscience data to assist in informed mineral resource management and development. The responsibility of the Geological Survey does not end with the completion of field or laboratory research, whether these have been carried on by Geological Survey Branch staff or in cooperation with geoscientists in other organizations. The knowledge acquired in such research must be made available to government, industry and the public in formats which will encourage use and improve access. Product style and design greatly affect the perception of the quality of the geoscience research, and the accuracy of the resulting data.

The English language is a highly flexible vehicle for communication so use it to advantage. The rules, forms and suggestions contained in this manual are to help in the process of writing, as is the Editor. They cannot, however, make up for poor science or the lack of scientific creativity so the real burden in producing any scientific publication will always lie with you, the author.

Over the years the Ministry has used a variety of guides, some of which were products of other agencies and others which were published guidelines or unpublished compilations of methods, procedures and usage. The objective of producing this style guide is to bring together those elements of tradition, good grammar, scientific excellence, and the procedures which make the publications of the Geological Survey Branch a valuable contribution to British Columbia's geoscience database. In doing so, however, it is necessary to confront the problem that much of our style and usage is affected by the technology applied both to the basic research and to the methods of publication preparation. This manual is offered as a guide, but should improved methods of presentation, formatting or preparation become available our products will evolve.

This guide is provided for researchers anticipating publication by the British Columbia Geological Survey Branch. Perhaps more importantly, it is a reference for editors and typesetters which will help ensure consistency in style, usage and format in Geological Survey Branch products.

Brian Grant
Editor
Geological Survey Branch
April 1992

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GEOLOGICAL TIME SCALE and Standard Symbols ***on Back Cover***

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INTRODUCTION

"In dreams I see it praised and prized
By all, from plowman unto peer;
It's pencil-marked and memorized,
It's loaned (and not returned, I fear);
It's worn and torn and travel-tossed,
And even dusky natives quote
That classic that the world has lost,
The Little Book I Never Wrote."

... My Masterpiece
by Robert Service.

The mandate of the Mineral Resources Division of the British Columbia Ministry of Energy, Mines and Petroleum Resources includes the timely publication of geoscientific and technical data that will assist in the discovery and evaluation of the mineral resources of the province, and lead to developments with lasting economic and social benefits. This manual has been prepared for the guidance of authors preparing manuscripts for publication by the Geological Survey Branch of the Mineral Resources Division.

This style manual, outlining the elements of good scientific writing and Geological Survey Branch usage, has been written for the guidance of authors, editors, secretarial and publications staff. Please review the guide before you start to write – this may save everyone many hours of needless work recovering from inadvertent mistakes.

PUBLICATIONS OVERVIEW

The B.C. Geological Survey Branch, Mineral Resources Division produces several series of publications which have evolved over time. They include:

Bulletins: The Bulletin series, the top-of-the-line branch publications, were begun in 1940. They are written on completion of **major research projects** and document the author's final and considered thoughts on the topics covered; they should present results that will be acknowledged by the scientific community as major contributions and which should have a shelf-life in excess of 20 years. The text is phototypeset in two-column format and maps, produced by the Branch cartographic staff, may also be printed/plotted in colour. Colour photographs and illustrations may be included if appropriate.

Papers: The Paper series was first published in 1978. It now includes the annual publication **Geological Fieldwork** and scientific reports that are the result of routine mapping or research programs. They are usually less comprehensive than material published in Bulletins and may contain other material of broader public interest. These publications have a shelf-life in the order of 10 to 20 years. Papers are printed in two-column format usually from laser-quality camera-ready copy; colour is not normally used in maps, figures or plates.

Geological Fieldwork: This annual report is published in January and is comprised of brief manuscripts outlining the results of field and laboratory research completed by the Geological Survey Branch staff and external authors during the preceding year.

Exploration in British Columbia: This annual publication was first issued in 1969 under the title of *Geology, Exploration and Mining in British Columbia* (GEM). It comprised chapters covering mining and exploration activity in the metals, placer mining, structural materials, industrial minerals and coal industries, and incorporated geological and technical reports that were previously contained in the Minister's annual reports. In 1975 it was separated into three parts and has since evolved into two publications, *Mining in British Columbia* and *Exploration in British Columbia*, the latter compiled by Geological Survey Branch staff.

The *Exploration in British Columbia* volume is published annually at mid-year. From 1990 onwards it contains two parts:
Part A : an overview of private sector exploration activity in the previous year, compiled by district geologists;
Part B: scientific reports on topics of economic interest and descriptions of mineral properties. The tenor of these reports is strong on observational geology and they may or may not be definitive geological descriptions of the properties or topics under discussion. Both staff and external authors may contribute.

(Part C: —a computer-generated summary of assessment reports submitted during the year, was last included in the 1989 edition and the data are now published in the Assessment Report Index.)

Geoscience Maps: This series, started in 1991, comprises all geoscience maps which represent finished products from Geological Survey Branch projects. They include geological maps with legends and commonly, short marginal notes. They may be used to accompany Bulletins or Papers. They are produced by offset press, usually at 1:50 000 scale although this may vary depending on the nature of the data being presented.

Preliminary Maps: Preliminary Maps are professionally drafted and may be reproduced by offset printing or

quick-copy methods. They may include explanatory notes or tabular data, but not extensive text.

Mineral Potential Maps: This series of 1:50 000-scale maps was started in 1991. Mineral potential studies are an integral part of regional mapping and resource studies. The information contained in this series of maps is intended primarily for resource management and to assist in area selection in the exploration process. These maps are produced by diazo or equivalent printing process and are intended to compliment Geoscience Maps or other publications.

Open Files: The Open File series of reports and maps is designed to place information in the hands of the public as quickly as possible. Maps are reproduced by diazo, or equivalent printing processes and reports are printed from laser-quality camera-ready copy. Rigorous editing procedures do not normally apply. The Open File series of publications includes the Assessment Report Index, MINFILE and RGS releases as well as maps and reports from various geoscience research projects.

Assessment Report Index: This series consists of a computer-generated index of assessment reports with limited descriptive material. It is updated annually.

MINFILE & Regional Geochemical Surveys (RGS): These are major databases of technical information, in digital and hard-copy formats, on mineral occurrences and geochemical surveys carried out across the province. They are valuable contributions to the geoscience database but are not usually presented as written manuscripts. Data are normally released in datasets for 1:250 000-scale map sheets but customized datasets may be produced. Editing, when required, is consistent with Open File quality.

Information Circulars: The Information Circular series of publications is relatively new to the Geological Survey Branch. It includes such products as *Exploration Review*, *MINFILE Coding Manual*, *Catalog of GSB Publications*, the annual *Project Inventory*, and numerous brochures regarding information and services provided principally by the Geological Survey Branch. These publications are normally distributed free of charge.

These publications are commonly updated on a routine basis. Some Information Circulars are intended for specific audiences and receive restricted distribution: examples include the schedule of events for the Cordilleran Roundup and the *GSB Field Manual*.

Release Notifications: This series is intended to inform Geological Survey Branch clientele in industry, government, academia and the general public of the availability of new publications and services. It is also a format for announcing events concerning government activities, of special interest to the mining industry. Release Notifications are mailed as publications production warrants.

Videos: The video series of publications is intended for the quick release or dissemination of scientific information in an informal format. Videos are normally compiled by external contractors from technical presentations at major conferences or workshops. These publications are not subject to normal Branch editorial procedures.

* * *

Publication procedures and detailed guidelines for the preparation of manuscripts for *Geological Fieldwork*, *Mineral Exploration Review*, *Exploration in British Columbia* and Open File maps and reports and Information Circulars are included in this guide.

ACKNOWLEDGMENTS

The compilation of information contained in this guide has taken much time and effort; the job was made immeasurably easier by being able to consult classic guides published in earlier years by the Geological Survey of Canada, the U.S. Geological Survey and, of course, those prepared by staff of the B.C. Geological Survey Branch.

The finished product you now hold, with all its warts and wrinkles, is the responsibility of the authors. We do, however, wish to thank many Branch staff for their comments, whether they realized they were contributing or not. Perceptive observations by Tom Rafter, Jr. and Dani Alldrick added a final polish which has greatly improved readability.

ALL MANUSCRIPTS

The publication process varies greatly in detail from one publication series to another, particularly when comparing material processed by desktop publishing techniques versus offset-printing technology, but it follows these basic steps:

- Authors submit a *Project Initiation Form* (PIF) to the appropriate manager and the director, to obtain approval to begin manuscript preparation (*see* Appendix for an example)

  Completion of a PIF is the first step in the publication process. This simple form identifies the manuscript by title, author and intended publication series. The author's section manager and the Chief Geologist signify their approval to start the writing and publication process; later, the section manager will approve the completed manuscript and the Chief Geologist and Editor will authorize going to press.

  The PIF also provides the Editor with the information needed to apply to the Communications Branch of the Premier's Office for a *Communications Project Approval* (CPA). Funds to cover printing costs and other publication expenses cannot be committed until a CPA number is approved.
- Authors submit a word-processed (MSWord, DOS format) manuscript, accompanied by the signed PIF, to the Scientific Review Office (SRO) for preliminary editing. This manuscript should be double spaced and accompanied by drafts of all maps, figures, plates and tables with appropriate captions. (Please consult the Editor regarding files from other word processors).

  Note: *If the manuscript will be published as a Bulletin a clean hardcopy, with reasonable copies of all maps, tables, figures and plates, is submitted to the Editor for external review before editing by SRO staff. External reviewers are selected by the Editor after consultation with the author and the appropriate manager.*
- The complete hardcopy, edited manuscript is returned to the author for revision and approval.
- The manuscript is resubmitted to the Editor in hard copy with all text on 5¼" IBM-compatible (DOS) computer diskettes. No significant revisions will be accepted beyond this stage. However, if significant scientific problems are identified, the draft will be returned to the author for revision and resubmission. It should be accompanied by a brief description of the report for use in a Release Notification or other promotional material.
- The manuscript is formatted to Branch standards and receives a second edit primarily for usage and formatting.
- If maps and line drawings are to be drafted by the cartographic staff, the work will be scheduled by the Editor, in cooperation with the Chief Draftsperson. Normally only illustrations for Bulletins or Papers will be drafted by the cartographic staff.
- The approved manuscript is either forwarded to the printer for production of **galley proofs**, or equivalent camera-ready copy is generated by staff of the Scientific Review Office. If camera-ready copy is produced in-house the resulting proofs are the final version prior to printing - they are equivalent to the blueline proof in the typesetting process.
- The **galley proofs** are read and corrected by the author and editor. All typographical errors should be corrected at this stage. Final versions of maps, line drawings and plates are approved by the Editor.
- Galleys are returned to the printer, with a page mock-up, for preparation of paged proofs. Decisions with respect to the sizing of figures and plates are made by the Editor and author, at this stage.
- **Page proofs or camera-ready copy are corrected and signed-off by the author, section manager and Director and approved by the Editor**. Changes at this stage are expensive; they **must** be minimal and confined to the correction of errors and omissions on the part of the printer.
- A **blueline** is printed and approved by the author and editor. (this applies to Bulletins and some Papers only)
- The selling price and the size of the press run is established, a Release Notification is prepared, and the volume is printed. Distribution is normally carried out by Crown Publications Inc.

* * *

Substantive changes should be incorporated in the manuscript before it is updated following the initial edit(s). Editorial comments are intended as suggestions for improvement of the manuscript; do not hesitate to discuss them with the Editor.

Only in exceptional circumstances will substantial revisions be accepted at the galley proof stage. Galley proofs afford the author an opportunity to correct typesetting errors, but are not intended to be a vehicle for extensive revision or addition of new material. In most cases both the author and Editor will review the galleys.

Few, if any, changes should be required on the page proofs, provided both author and editor have been conscientious at the earlier stages. Page or camera-ready proofs are provided primarily as a check on the placement of illustrations and captions, and to ensure that the overall layout is satisfactory.

Blueline proofs are provided as a check for gross errors in the printing process, such as pages out of order or printed upside down - NOT for last minute second thoughts on the part of the author. It is very expensive to insert major corrections at this stage.

EXTERNAL JOURNALS

Manuscripts intended for external publication must be approved by the appropriate section manager and the Chief Geologist prior to a brief review by the Editor.

Peer review is strongly recommended; most journals edit to their own style and usage in addition to submitting manuscripts to scientific review.

The SRO will not normally carry out a rigorous edit of these manuscripts but will review final drafts for consistency with Branch standards. Rigorous edits may be arranged at the author's request. A printed copy of the manuscript, with all illustrations, should be submitted to the Editor with a completed Publication Initiation Form.

PUBLIC RELATIONS MATERIAL

All Branch advertising or public relations material must be approved by the Ministry's Director of Communications as well as the Chief Geologist. This manual does not deal specifically with such products and you must contact the Editor or the Director of Communications for guidelines.

Ministry staff should provide the Editor or the Director of Communications with details of Ministry participation in local events and activities. This information will be made available within the Ministry to document such activities and to provide a calendar of activities.

Information should include a copy of a brochure if available, meeting name, location, date(s), name of Ministry participants, type of participation (*i.e.* talk, poster, demonstration, technical instruction, *etc.*), the major sponsor(s) or coordinator, details of registration (*i.e.*, costs and timing).

STYLE & FORMAT

The purpose of scientific and technical writing is to convey information to the reader as clearly and concisely as possible. Writing is very much an expression of personality; scientific writing is no exception. Many aspects of geological writing are inherently repetitive and it is a challenge to write a report that holds the reader's full attention and leads irresistibly towards a clear and logical set of conclusions. The Editor's responsibility is to ensure a level of conformity and continuity essential to maintaining the integrity of Geological Survey Branch publications, while trying to avoid undue violence to the author's style. The purpose of this manual is to provide guidelines which will help both authors and editors achieve these objectives; it is not intended to be a straightjacket of rigidly imposed rules that stifle creativity and lead inevitably to dull and stilted writing. Good scientific writing is a difficult art; within the established framework, you should strive to develop a style that reflects your individuality.

Manuscript *style* refers to each author's choice of words, paragraph and sentence construction, punctuation, capitalization and other small details that distinguish one writer from another. Manuscript *format*, on the other hand, relates to the physical appearance of the finished publication; it is concerned with the selection of typeface and type size, paper and binding quality, page layout and so on. Format is a matter of editorial policy, influenced not only by the scientific content but by production costs and the purpose of a particular publication. Nevertheless, authors are encouraged to discuss with the Editor how their work will be presented to the public. They can help expedite the editorial and production process by making sure the structure and content of their manuscripts conform to the guidelines set out in this manual.

Authors are encouraged to review those publications listed later in this guide, under the section *Other Sources of Rules and Inspiration*, for supplementary details on grammar, style and usage. Authors wishing to improve their writing style are strongly encouraged to read the booklet prepared by Robert L. Bates, and published by the American Geological Institute, entitled *WRITING in Earth Science*. This booklet clearly identifies many pitfalls which geologists may encounter and offers some solutions. More importantly, it discusses the process of preparing for and compiling a scientific report which will achieve the objective of communicating new ideas and information to a client group with broad interests and a wide range of technical skills.

The relationship of author and Editor in this process is critical. The geologist's aim is to provide lucid descriptions of field observations and present opinions and conclusions with conviction, and that is achieved best by employing a simple and straightforward style. The editor must try to maintain the author's original style while ensuring the material is both scientifically sound and consistent in style and usage with all other Geological Survey Branch products. These aims are not in conflict, but require the cooperation and understanding natural to any professional team.

Authors should keep in mind that some of their readers may not be formally trained in geology, or well versed in the latest geological jargon; many prospectors are avid readers of British Columbia Geological Survey Branch and other provincial, state and federal government publications, but find an excess of pseudoscientific language makes for very heavy going. At the same time esoteric language will certainly not impress a professional who knows what your are really trying to say. As McKinstry (1948) points out:

"The young graduate, especially, needs to curb his inclination to use technical terms gratuitously in the subconscious desire to display his learning. It is not a bad plan to go through a report with a blue pencil and see how many common words you can substitute for ten-dollar technical ones. This will make the going easier, even for the scientific reader and embarrassingly enough, it is likely to expose any vagueness of ideas that may be hiding behind impressive double-talk."

Alas, this characteristic of scientific authors has not disappeared and is by no means confined to young graduates. At least the advent of computer word-processing makes the blue-pencil exercise a great deal easier.

PLANNING & PREPARING MANUSCRIPTS - THE PRINCIPAL ELEMENTS

The subject matter of all but the shortest reports must be subdivided. The largest subdivisions may be formally designated as chapters, as in the Bulletin and Paper series, or simply introduced as a major subheading. The opening paragraph(s) of each major section should provide the reader with a brief statement of what it contains; this opening statement may be designated *Introduction*, but this is not necessary.

The report should be organized to pass from the general (Introduction, Regional Geology and the like) to the particular (detailed results of the research) and back to the general again (Conclusions). There should be conceptual links between each chapter and from one topic to the next within each chapter; care should be taken to ensure that these links are clear to the reader. Each topic should be fully covered before you move on; if you find it necessary to reintroduce a topic that has already been covered, you should reconsider the way the manuscript is organized.

GETTING STARTED - THE OUTLINE

Most successful reports are written around a clear and concise outline; it will identify the topics that you intend to cover, assure that they are treated in a logical order, and may indicate gaps in your research. Your manager will want to review the outline with you before signing the PIF and it will subsequently form the basis of the Table of Contents in longer reports.

A list of major topic headings does not constitute an *outline*. It should also include notes on the material to be covered and the way in which the data will be presented. The more detailed the outline, the easier the actual writing will be. Noting the topics to be covered under each subheading, will help you organize the presentation of your data and conclusions in the most logical way. Long manuscripts are often prepared over an extended period of time and the earliest chapters are not always the first to be written. A detailed outline will help you to avoid needless and irritating repetition of points that have already been made elsewhere in the text – a common fault in many manuscripts.

TITLES, KEYWORDS & HEADINGS

The need for explicit titles, which lend themselves to cross-referencing, has become increasingly important with the development of computerized information retrieval systems based on keywords and subject concepts. **The title of a report should CONCISELY and clearly indicate the nature of the material it contains, the location of the area described and, whenever possible, a meaningful National Topographic System (NTS) reference**; for example,

> Geology of the Badshot Formation, Southeastern British Columbia (NTS 82F)

Volume, chapter or other headings must be concise but descriptive. Complex headings will quickly discourage potential readers and add unnecessary problems in formatting and layout.

Librarians do not have time to analyze every publication in detail; in the case of long reports they rely on the summary and subject headings listed in the Table of Contents to outline the subject material. In shorter papers, particularly those published in the annual Fieldwork and Exploration volumes, keywords are included for referencing purposes. *Keywords* may include phrases up to 50 characters in length and should indicate the key concepts and topics covered by the manuscript. The first keyword should place the manuscript in a broad subject category such as *Economic Geology, Geochemistry, Coal Geology, Regional Mapping, Surficial Geology* or *Geochronology, etc.* Subsequent keywords should provide details for manuscript content and focus.

Use the *KISS* principle when creating titles and headings – *Keep It Simple Stupid!*

AUTHORSHIP

More than one person may be involved, in one way or another, with writing a report. It is important to know who wrote what; acknowledgment of scientific assistance is not merely a matter of giving credit but is an assignment of responsibility for the accuracy of statements.

If two or more authors have each made an equitable contribution both to the research and to the writing of the manuscript, the report has full **joint authorship**; the order in which authors are listed must be decided by mutual consent.

In the case of **contributed authorship,** the senior author, whose name appears first, is normally the leader of the project and has had major responsibility for the research or preparing the manuscript.

Supporting contributions to a research project are often provided by other scientists not directly involved in the project, for example, age determinations, petrology and geochemical analyses. It is not customary to name all contributors as authors, but if the information is extensive, it should be grouped in a table, or as an appendix, under the name of the scientist(s) responsible, so that it can be easily cited in other publications. Where this is not possible and such contributions appear throughout the text, they must be individually acknowledged.

(*see* section on Acknowledgments for treatment of author affiliations, particularly for external or contributing authors; also *see* Captions section)

* * *

Authors should carefully note how they identify themselves and **be consistent across the range of publications, maps, and external publications**. This will make both cataloging and compilation of reference lists much easier and will ensure you have credit appropriate to your products. (*e.g.* do not use W.T. Brown, Bill Brown, William Brown *etc*. on different maps and publications.)

This does not mean that you may never change your name or title. It may be appropriate for Dani Alldrick to become Dr. D. Alldrick; or if marriage is in the works, a change of family name may be desired, *e.g.* K.P.E. Andrew becomes K.P.E. Dunne (*also see* section on References for treatment of such cases).

CATALOGING IN PUBLICATION (CIP)

Cataloging In Publication is an international program of cooperation between librarians and publishers; it must be done prior to printing all significant provincial government publications. The Legislative Library of British Columbia supplies CIP data for all Geological Survey Branch publications at the request of the Editor.

Current convention places the CIP in the lower left corner on the back of the title page or cover (*see* inside cover of this guide for an example).

FOREWORD OR PREFACE

A Foreword or Preface by the Chief Geologist may be included in major publications. It usually outlines the scope and purpose of the study and indicates how it contributes to Branch objectives.

SUMMARY

A Summary must be submitted with all stand-alone manuscripts, but is not required for shorter papers that will be published in a collection of works by a number of authors. It should be concisely written and have a maximum length of 2500 words; most summaries will be much shorter. It should state the purpose of the study, outline the methods used and report the results and conclusions. A well-written summary will provide readers with the flavour of the report and allow them to decide whether they wish to read it from cover to cover. **It will also form the basis of a Publication Release Notification** when your manuscript is at the printing stage and available for distribution to the public.

TABLE OF CONTENTS

The Table of Contents is a shortened version of the outline; it lists the principal headings in the report, together with the illustrations (plates, tables and figures) and appendices. The first four heading grades (including chapter headings) will normally be listed. If captions for illustrations are longer than one sentence, write a shortened version for inclusion in the Table of Contents.

INTRODUCTION

The first chapter of a major report, or the first section in a shorter paper, usually designated as the introduction, should open with a concise outline of the project's objectives and how it contributes to the objectives of the Geological Survey Branch. Other topics usually covered include the size and location of the study area, its physical features, access, and a short discussion of its economic significance or potential. Climatic conditions may be touched upon, if they are in some way exceptional or particularly pertinent to working conditions in the area, but lengthy descriptions of the climate, vegetation and wildlife are not usually rele-

vant in a geological report. Long introductions should be broken up by the use of subheadings.

GENERAL GEOLOGY

This section establishes the framework for the balance of the report. It generally contains three principal subsections, a general statement, a Table of Formations, and descriptions of the rock units which appear in the legend of the accompanying map. Depending on the emphasis of the work, these descriptions may also constitute separate chapters. This would be appropriate in a report on a regional mapping program, but if the topic is more specialized, a paper on applied geochemistry for example, and extensive lithological detail is unnecessary, they are better included under this general heading.

GENERAL INTRODUCTION

The introduction is usually brief, although in some cases it may be expanded to advantage. Its purpose is to outline the **regional geological setting** and provide an overview of the geology of the study area, with particular emphasis on the regional framework. Details should be avoided and conclusions may be presented without supporting evidence; this will be included later in the report.

This opening statement does not normally require a separate subheading, either in the text or in the Table of Contents, as it appears immediately under the heading General or Regional Geology and its purpose is obvious.

TABLE OF FORMATIONS

The Table of Formations is a table, not a figure!

Few pages in the report will be referred to more often than the Table of Formations. It provides a concise summary of the geological history and stratigraphic relationships of the area, and its preparation requires close attention to detail. Formations is used here in the broadest possible sense; the table should include all rock types, arranged in their assumed stratigraphic order. The nature of the contacts between them should be indicated where possible, by such terms as unconformity, disconformity, intrusive contact, gradational contact or fault.

The table generally has four columns; the first three indicate the **geological period, epoch** and the name of the **rock unit**, the fourth provides a **terse summary of the lithology**. Where stratigraphic thicknesses are known, or have been estimated, they can be shown in the column containing the formation names. A fifth column, showing map symbols, may be included at the author's discretion. These symbols may be either time-unit alphabetical designators or arabic numerals, arranged from oldest to youngest from bottom to top. Symbols must be consistent between text illustrations and major maps in pockets. (*see* example illustration)

DESCRIPTION OF ROCK UNITS

When included under the heading General Geology, rock type descriptions should be quite brief and confined to essential characteristics. Detailed descriptions are best included as a separate chapter (*see* Lithology). Whichever choice you make, it is customary to describe stratified units first, **in order from oldest to youngest,** followed by intrusive rocks, also describing the oldest first.

DETAILED GEOLOGY

LITHOLOGY

The manuscript should contain detailed descriptions of each major rock unit in order from oldest to youngest. Intrusive rocks should be dealt with in a separate subsection and again in order of oldest to youngest.

Detailed rock type descriptions may include, in the following order:

- The origin of the group or formation name and the location of the type section or area.
- Distribution and thickness of the unit.
- Lithological description, megascopic followed by petrographic.
- Interpreted depositional environment.
- Structural relationships, internal followed by external contact relationships.
- Metamorphism.
- Age, including paleontology.
- Correlations.
- Lithogeochemistry.

Authors must decide which, if any, of these topics will be discussed in sufficient detail to warrant chapter status or a new major heading. Paleontological information and bed-by-bed descriptions of stratigraphic sections are important aspects of some reports; they should be treated separately, under a heading such as Stratigraphy. Similarly, if extensive lithogeochemical data are to be reported, these too are best included under a separate heading.

STRATIGRAPHY

As suggested above, a separate section on stratigraphy will not be necessary in many reports, but should be used if detailed stratigraphic and paleontological data are to be presented.

TABLE OF FORMATIONS

PERIOD	EPOCH	FORMATION	MAP SYMBOL	LITHOLOGY
Quaternary	Pleistocene & Recent		11	Till, alluvium
Tertiary	Eocene	Late sills, dikes	10	Diabase dikes and sills
	Paleocene	Otsala Batholith	9	Porphyritic quartz-latite monzonite
Cretaceous	Late	Kantrell Intrusions	8	Hornblende-biotite granodiorite, quartz monzonite, quartz diorite and porphyritic hornblende diorite
	Early	Kobar Intrusions	7	Quartz-latite prophyry, dacite porphyry, brecciated quartz-dacite porphyry
Intrusive Contact				
Jurassic	Middle	Tsaklasa Group	6	Subaerial and submarine volcanics. Rhyolite, quartz-trachyte welded as tuffs, lapilli and crystal tuffs, agglomerate and breccia. Minor andesite flows and breccia.
	Early	Sunnie Formation	5	Submarine volcanics. Andesite, basaltic andesite and trachy-andesite. Flows, pillow lava and breccia. Minor interbedded argillite.
Angular Unconformity				
Carboniferous	Moscovian	Durell Formation	4	Marine sedimentary unit. Pelitic shale, quartz-feldspathic sandstone, buff and grey argillite, siltstone.
	Bashkirian	Arrow Formation	3	Lithic arenite and feldspathic wacke, grey pelitic shale and muddy conglomerate.
	Serpukhovian	Ascott Formation	2	Limestone, packstone, sandy limestone and calcareous siltstone.
	Unconformity			
	Tournaisian	Nells Formation	1	Argillaceous limestone, dolomitic chert, stromatolitic dolomite.

Note: Units are arranged in order of youngest to oldest - top to bottom. Map symbols may be numbers or chronostratigraphic symbols. (see illustration of chronostratigraphic symbols and usage on inside back cover)

Descriptions of measured sections must be prepared accurately and carefully. Much editorial time can be wasted in reorganizing descriptions and eliminating errors in thickness totals. Each bed or unit should be described in a logical order, and with consistent punctuation as follows:

- Major rock type, modifying adjectives, colour, grain size, weathering characteristics;
- Bedding and other structures;
- Minor constituents;
- Texture, mineralogy and related comments;
- Relative abundance and identification of fossils.

Extensive data should be presented in an Appendix to the report, not within the main text. Authors should consult with the Editor to determine the most appropriate format (*see* opposite page for example of content and format).

FOSSILS

Lists of fossils identified by outside agencies are often included in Branch publications. The accuracy of fossil lists, and any opinions concerning the age and formation correlations that are based on the fossil determinations, are the responsibility of the paleontologist who identified the fossils and who must be named in the text. Paleontologists' reports must be cited correctly and suitably acknowledged. Authors, critical readers and editors must all bear responsibility for ensuring that faunal and floral information is correctly cited and properly documented, but the primary responsibility rests with the author. Poorly documented paleontological information has little value and may even be misleading; it reflects adversely on the scientific integrity of both the author and the Geological Survey Branch (*see* Fossils under Special Punctuation & Formatting).

Extensive paleontological data are not normally included in Geological Survey Branch publications but if required, should be placed in an appendix.

GEOCHEMISTRY

A separate section on geochemistry is appropriate if extensive data are to be presented. In addition to presenting the data, it should describe the analytical methods and comment on the effects of alteration. If at all possible, raw analytical data should be tabulated and included as an appendix, but **summaries and interpretations, particularly in the form of graphs and illustrations, will enhance presentations**.

Given current technology it is very easy to generate huge amounts of data. You must exercise scientific judgement in deciding what is significant and should be published. **Avoid cluttering your report with irrelevant data just because it is available. Remember, your research activities make you the expert on the data at hand; you are the best qualified to interpret these data – don't burden your readers with the task!**

If your purpose is to make raw data available for readers to use as they see fit, you should consider providing the information on computer diskettes which may be bound into the rear of the report; or made available on request, from the author.

STRUCTURAL GEOLOGY

Discussion of the structural geology should be introduced by a brief outline of how the study area is divided into structural units, leading into a broader discussion of each phase of deformation, taken in order from oldest to youngest.

Regional structures are usually best illustrated by interpretive diagrams and sections. Detailed features may be illustrated by high quality photographs supplemented by labels and descriptive captions.

METAMORPHISM

Discussion of metamorphism should be introduced by a brief summary of metamorphic classifications and general information on why and how such classifications were assigned. Metamorphism should be described in a logical sequence of regional then local characteristics.

If rocks in a research area may be defined by texture and degree of metamorphism then the metamorphic classification should be presented in similar fashion to stratigraphy. Descriptions of recognizable units must be prepared and each distinctive unit should be described in logical order of metamorphic grade or structural position. Type sections should be identified where appropriate.

In most cases where metamorphic effects are secondary in significance, they should be included in the stratigraphic descriptions.

ECONOMIC GEOLOGY

Many readers, particularly those directly involved in the mineral exploration industry, may regard this chapter as the most important part of the report. You should bear in mind that dissemination of information that will stimulate economic activity is a major objective of the Geological Survey Branch. Do not skimp on this chapter.

Discussion of the economic geology of an area should include descriptions of all known mineral deposits and occurrences, together with commentary and conclusions where appropriate. **Exercise caution in drawing conclu-**

EXAMPLE DESCRIPTION OF STRATIGRAPHIC SECTION

Section 123
Hobs Formation - Standard Creek Area

Location: 3-4 km south of Kalvin Creek - Maah River confluence.
Elevation of Unit 1, 2100 m. NTS 93H/12.
Measured by J. Francis (1992), Traverse JF 92X45

UNIT	DESCRIPTION	THICKNESS (metres)	HEIGHT ABOVE BASE (metres)
	Grewsom Formation (incomplete)		
7	siltstone, dark green, weathers reddish orange, thin to thick bedded; siltstone, purple, with disseminated magnetite octahedra, 1 m thick layer approximately 4 m above base of unit; sharp basal contact	8.0	380.0
	Hobs Formation (372.0 m - complete)		
6	lava, dark green, massive or quartz-filled amygdaloidal	157.0	372.0
5	siltstone, dark green, medium to thick bedded, thinly laminated	27.0	215.0

sions; it is the responsibility of government scientists to present the facts and geological interpretation, not to pass judgment on the economic viability of a mineral property. The opinions of government geologists are respected by industry and hasty or ill-conceived conclusions, based on insufficient data, are likely to be acted upon, with serious repercussions for all concerned.

Latitude and longitude, together with NTS designation and MINFILE number, must be included in all descriptions of mineral occurrences, preferably in a tabular format at the head of each description; **if the occurrence you are describing is not recorded in MINFILE it is your responsibility to ensure that relevant details are coded and submitted to the MINFILE system.** It is also strongly recommended that new descriptions or significant data on mineral occurrences be documented and submitted for publication in *Exploration in British Columbia*.

Descriptions should include details of the geology and mineralogy of the economic mineralization, and the geology of the hostrocks. A brief outline of the exploration history and any meaningful assay or production data that are available for the occurrence should be included. Production and reserve data must be supported by appropriate references. **It is not the mandate of government geologists to make ore reserve estimates** from raw data that may be available. Good judgement must be used in characterizing mineralization by quoting assay results on grab samples, or best assays: such data are often misleading and best avoided. It is preferable to quote average grades.

Discussion of mineral potential may be critical to the value of a regional mapping or mineral deposit study. Regional and local ore controls are critical to making informed judgements on economic potential; these may be structural, stratigraphic or chemical. Authors should keep in mind that it is the policy of the GSB to produce mineral potential maps from all mapping programs to aid in mineral exploration and land management activities.

ACKNOWLEDGMENTS

General acknowledgments should be made collectively, either in the final paragraph of the introduction, or under a separate heading, preferably at the end of the text, before the References or Bibliography. It is unnecessary to mention general assistance by staff of the branch, provided as a matter of course as part of their routine work, unless the contribution has been of major importance.

Individual acknowledgments are a way of saying thank you for help and support during your research. Be aware that they say a great deal about the personality of the author. Most people like to see their name in print, but avoid overdoing it. **Too many acknowledgments tend to cheapen their value and readers may start to wonder if you actually contributed anything to the research.**

If you must use formal language you must also use formal names. Do not mix sheep and goats as in: *The author is deeply indebted to Dr. Marg Bloggs for guidance and inspiration.* If you wish to be formal, use: *The author is deeply indebted to Dr.Margaret Bloggs...*; or, at the other end of the spectrum: *I would like to thank Marg Bloggs for advice and support.*

Authors should not mix styles as in: *The author is indebted to John Arsenault and Dr. Paullin.* Grant everyone either formal or informal names but not both in the same acknowledgment.

Courtesy titles, such as Mr., Mrs., Miss, Ms *etc*: should rarely be used. It is preferred that names or initials be used without gender-specific modifiers.

AFFILIATIONS

It is not Ministry practise to include titles or affiliations with authors' names on the covers of published reports. If assistance with publications has been significant, supporting persons or agencies should be identified in the acknowledgments. In some cases affiliations may be included in the details on the inside cover page.

In volumes such as *Geological Fieldwork* and *Exploration in British Columbia* it is normal practise to include the name of the organization with which the author is affiliated. This may be their current organization or that under which the research was carried out, but not both. Addresses and other details are not included.

Geological Survey Branch staff do not have the organization name included unless it is for clarification in those occasions of multiple authors with numerous affiliations.

ACKNOWLEDGMENTS & COPYRIGHT

Excerts from published works are protected by copyright. [*see Copyright Act*, section 17, sub (2) (A)]. The critical factor is, not the number of words, but the significance of the words or material, or the proportion of the text that is quoted. If a quote of 20 words represents the core of a Ph.D. thesis, reproducing it could be regarded as a copyright violation.

Giving credit to the copyright owner or the author does not constitute license to reproduce material without written permission. Contrary to widely held belief, simply acknowledging a copyright owner does not meet legal requirements. **However, information itself is not subject to copyright only the words in which it is expressed.** By rewording information an author can express the same ideas, although acknowledgment is still expected on ethical grounds. It is good scientific practice to err on the side of over acknowledgment when reproducing ideas or illustrations.

REFERENCES OR BIBLIOGRAPHY

This section follows the main body of the text. The terms References and Bibliography are not synonymous and are used as follows:

References: Used when each publication listed is cited at least once in the text. This is customary Geological Survey Branch usage.

Selected Bibliography: The References are expanded to include other publications related to the subject matter but not specifically cited.

Bibliography: An attempt has been made to list all available literature relevant to the subject, in some cases even indirect references.

Recommended Reading: Used only in publications of a general nature where full technical reference lists are not appropriate but where the reader may wish to pursue detail not covered in the publication.

The Geological Survey Branch uses the author/date system [*e.g.*, (Jones, 1984)] for citations in the text referring the reader to the References. Publications listed in the References are in alphabetical order by author(s) and then date. Care must be taken to ensure that each reference is complete and accurate. This is the responsibility of the author. Errors in references are among the most common problems encountered in manuscripts. Remember that inaccurate or misquoted references reflect badly upon the quality of your research, your credibility as an author, and the scientific integrity of the Branch.

Only material that has been published or that is *in press* or *in preparation* should be included in the reference list. Material with limited circulation, for example university theses or internal company reports, may be included, but a likely source should be indicated. Unpublished material such as personal communications should be identified as such in the text (*e.g.*, J.J. Smith, personal communication, 1985) but should not be included in the References. **If no author is given for a publication, the publisher or agency responsible for the work should be substituted.**

Internal cross-references to page numbers are not to be used. If internal references are necessary cite chapter and subheading details.

(For further information *see* section on References and Citations under Special Punctuation & Formatting.)

APPENDICES

Detailed information that is not essential to the text, and which would interrupt the flow if it were included, should be placed in an appendix. Detailed stratigraphic sections, lists of mineral or fossil localities, long tables of geochemical analyses, detailed petrographic descriptions or similar data are examples of the type of material that is best left out of the main body of a report. Needless to say, when this is done, the appendix must be referenced in the text.

Extensive analytical data or geological databases which may be of value to potential clients may be included on computer diskettes in an appendix or made available from the author(s). Increasing use of computer technology makes this a useful option in compiling reports but care must be exercised to disseminate significant NOT irrelevant data.

INDEX

An index is not generally included in Geological Survey Branch publications. If an index is required, it should be prepared at the same time as the Table of Contents and page proofs. Personal and corporate names, geographic and mineral property names, names of rocks and minerals, and geological provinces, terranes or units are the most common index references depending on the purpose of the publication.

Readers will start an information search in an index from differing perspectives – try to accommodate this with variations on keywords (*see* index at the back of this publication for an example).

FORMATTING MANUSCRIPTS

GENERAL

The following guidelines for preparing and submitting manuscripts are to assure uniformity of style, speed the editorial and typesetting process, and lessen the amount of updating required.

This style manual, outlining the elements of good scientific writing and Geological Survey Branch usage, has been written for the guidance of authors. **Review the style guide before you begin to write; manuscripts that require excessive editing time may be rejected.**

- Manuscripts must be word processed, preferably with Microsoft Word (DOS format).
- A Table of Contents, plate and figure captions, tables and appendices *etc.* must be included as separate files on DOS formatted, high-density diskettes (1.2 Mb).
- The double-spaced, **hard copy of the draft manuscript** must include all text, tables, figures, plates and captions.
- Copies of illustrations must be clearly numbered and marked for right-way-up.
- **Use your word processor to spell check your manuscript before submitting it for editing.** Remove all abbreviations.
- Double check your list of references to ensure they are complete, and composed and formatted in line with the Branch style.
- **Particularly for external authors, identify your name, address, phone and FAX numbers clearly on the title page of the manuscript.**

DIGITAL DATA COMPATIBILITY

In this age of electronic media it appears that information transfer is somewhat magical and hassle free. This is not necessarily so. Authors should be aware that there may be serious compatibility problems in transferring data between both software applications and hardware systems.

The Scientific Review Office has the technical capability to translate most data formats. However, authors should pay careful attention to galleys to ensure their material is typeset properly; Greek letters and mathematical symbols and foreign language characters (<, >, ±, ≥, ≈, ≤, α, β, ≡, δ, π, Σ, ö, «, », *etc.*) are particularly prone to glitches in computer translations due mainly to myriad versions of printer and screen fonts which may or may not contain the full IBM extended character set.

Authors using word processors they have programmed themselves, or perhaps purchased from an eccentric cousin, should ensure their submissions for publication are made well before established deadlines. This will allow sufficient time to identify and perhaps correct problems caused by unknown or troublesome data formats.

TYPING MANUSCRIPTS

Inputting manuscripts using word processors can provide a great deal of flexibility in preparing material for publication. Material input by disregarding the abilities of word processors or standard typing conventions will probably result in a great deal of unnecessary work and frustration at the formatting or typesetting stage.

Most word processors offer the capability to produce reasonably formatted documents which are acceptable for most administrative purposes. However, for great looking documents all manuscripts must be processed by desktop publishing software or the typesetting facilities of the Queen's Printer. Word processors do not have the hyphenation, kerning and other typographic abilities inherent to publishing systems.

FORMATTING GUIDELINES

TEXT

- Word processor of choice is MSWord5, DOS format.
- Text should be input flush left, not justified.
- Single spaces between sentences, *i.e.* one space between a period and the first letter of the following sentence.
- No spaces or extra lines between paragraphs.
- Use upper and lower case where appropriate but do not use all upper case to highlight text.
- Except for required punctuation text should always be typed in lower case format.
- Carriage returns are to be used **ONLY** at the ends of paragraphs never at the end of a line of text.

In some cases material will be typed and formatted by word processor only. For complete compatibility in such cases, documents in MSWORD5 should be formatted using the *SRO_LAN.prd* or *SRO_POR.prd* series of printer drivers for the HP Laserjet printer.

Summary Guide to Typesetting Formats – Titles & Headings

April 1992

"@Title = " **CHAPTER TITLES** (*e.g., Geological Fieldwork* and *Exploration in British Columbia*)
(14pt/ Bold/ Uc/ Centred with line under/ Page width (7")/ No zero in NTS #/ Starts new right hand page/ Times Roman)

CARBONATITES AND OTHER INTERESTING ROCKS IN BRITISH COLUMBIA (92G/12, 13; 92J/3, 4)

"@Author = **AUTHOR(S)** (12pt/ Bold/ Uc&Lc/ Centred)

By N.W.T. Bear and B.S. Goldsmith
University of British Columbia

"@Contribution = " **PROGRAM CONTRIBUTIONS** (10pt/ Italics/ Centred/ in parentheses)

(Contribution 123, Sullivan-Aldridge Project)

"@Keyword = " **KEYWORDS** (title: 10pt/ Uc/ italics; text: 10pt/ Normal/ Uc & Lc/ Column wide)

KEYWORDS: Regional mapping, Quesnel Terrane, placer gold, volcanic arc, geochemistry, industrial minerals, massive sulphides.

"@R1 = " **RANK 1 HEADING** (12pt/ Bold/ Uc/ left justified)

THE GNAT OPHIOLITE COMPLEX

"@R2 = " **RANK 2 HEADING** (Small caps: 12pt-9pt/ Bold)

GENERAL GEOLOGY AND GEOCHEMISTRY

"@R3 = **RANK 3 HEADING** (9pt/ Bold/ Uc)

STRUCTURE OF THE STUHINI GROUP

"@R4 = " **RANK 4 HEADING** (Small caps: 10pt-8pt/ Bold)

IMAGINARY FORMATION IN THE KOOTENAYS

"@R5 = " **RANK 5 HEADING** (10pt/ Bold/ Uc & Lc/ Colon after/ begins paragraph)

Unit 1 - Gabbro: The Adrien Lake intrusions include gabbroic rocks ...

"@Body Text = " **BODY TEXT** (10pt/ Normal/ Uc & Lc/ paragraph indent 0.25"/ Single space/ Justified/ Double column format at 3.25" each/ ~0.30" gutter/ 0.25" binding margin/ Times Roman)

The volcanics are correlated with the Brown Creek Formation of the Early Triassic Copper King Group. West of the Big Mac prospect, on Juniper Ridge, felsic volcanic rocks are assigned to the Big Salmon Formation...

"@Ref = " **REFERENCES** (9pt/ Normal/ Hanging indent 0.30"/ Publishing agency in italics/ 0.3" leading between references/ double column format/ Times Roman)

Graham, P.S., Handler, P.Q., and Shanks, S.E. (1992): Geological Investigations of Glacier Surging in British Columbia; *in* Geological Fieldwork 1992, B. Grant and J.M. Newell, Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1993-1, pages 203-208.

"@Fig = " **FIGURE CAPTIONS** (9pt/ Uc & Lc/ Justified/ 1 or 2 column format)

Figure 24. Generalized geology of the 1988 project area. Map shows claim outlines and major faults controlling mineralization in the area of the Moose Pasture sulphide showing.

TABLES

- **Tables must be submitted as individual computer files. Do not merge tables with the text of a manuscript.**
- Tables should be generated by software, such as EXCEL, for inclusion as camera-ready artwork in Open Files and Papers. Tables are usually typeset by Queen's Printer for Bulletins but may also be used camera ready from the author. Authors must be prepared to make all editorial updates to camera-ready tables to bring them into line with publication requirements.
- Word processed tables should be input using **TABs between columns of data. DO NOT USE SPACES TO ALIGN DATA** - final formatting of tables will be done by SRO staff or Queen's Printer. A hand drawn, dot-matrix or laser printed facsimile of the table will be sufficient for SRO staff to complete the formatting.
- Large tables, *i.e.* two or more pages of analytical data should be submitted as camera-ready, laser printed copy to a maximum size of 8 by 11 inches - either landscape or portrait orientation (portrait orientation is preferred for tables and illustrations). Please consult with the Editor if you plan to include large data sets in your publication.
- Table headings will be typeset by the SRO or QP to maintain consistency in type size and style.

MANUSCRIPT FORMAT

- Hard-copy draft manuscripts should have numbered pages, be double spaced and have about 1.5 inch margins on the left and right.
- Identify the rank, using R1, R2, R3, *etc.*, of section headings and subheadings immediately before such headings. This will aid editing and formatting.

  For complete Ventura-compatible coding these headings may be expanded to:

  "@R1 = " *Rank one heading*;

  "@R2 = " *Rank two heading*;

  "@R3 = " *Rank three heading, etc.*

  However, please check with the Editor BEFORE spending time inputting codes which may or may not be of any use! (*see Guide to Typesetting Formats – Titles & Headings* for details)
- **Underlining of text is not acceptable for Branch publications.** An underline not only destroys the visual appeal of printed text but presents difficulties in printing as they usually cut text descenders and cause ink to blotch.
- Figures, plates and tables are normally inserted immediately after they are first referenced in the text and consistent with good page layout techniques. It is important that you insert references to all illustrations you wish to appear in the final publication.
- **Captions for figures, plates and tables must accompany the text file.** They must be appended to the end of the main manuscript. A summary form of these captions should also be included for use in a Table of Contents.

DO NOT'S

- DO NOT hard code page numbers and page breaks – use your word processor's automatic pagination for printing.
- DO NOT cross reference within the manuscript using page references. Such references are easily missed during the formatting and the final page numbers rarely correspond to those in the original draft. It is better to reference sections or chapters and, best to eliminate such references if possible.
- DO NOT use word processor generated graphics, *e.g.* boxes, around text. These are totally incompatible with desktop publishing or typesetting equipment.
- DO NOT indent the first lines of paragraphs. This will be done electronically in the typesetting process.
- DO NOT use multiple columns, centred, hyphenated or justified text.
- Absolutely DO NOT hyphenate text with MSWord or a similar word processor before submitting your file on diskette for publication – unless you prefer very strangely hyphenated words in your manuscript.
- DO NOT use Style Sheets or equivalents with word processed documents.
- DO NOT merge tables with the text of word processed documents!
- DO NOT insert footnotes *etc.* electronically. Such items must be included with the figure and plate captions at the end of the text file, or in a separate file.
- DO NOT use carriage returns at the ends of lines of text; they were necessary with the old, manual typewriters but cripple the advantage of modern, computerized systems.

Consult the Editor Before, Not After!

If you have questions on any aspect of preparing and submitting manuscripts for publication by the Geological Survey Branch, please consult the Editor BEFORE you spend a great deal of time formatting. The Scientific Review Office would much prefer receiving unformatted ASCII files rather than files formatted and input by unique and incompatible methods!

"Go ahead and ask a dumb question – it's much easier to deal with than a dumb mistake!"

Anonymous

PREPARING ILLUSTRATIONS

Illustrations comprise maps, line drawings (figures), photographs (plates) and some tables. When preparing illustrations, give careful consideration to the size and format. Illustrations larger than page size (>9 by 7 inches) are expensive to print and must be inserted in a pocket or folded and tipped into the final product, which increases publication costs. Large maps are an essential feature of many reports, but the inclusion of many large maps is to be avoided if possible. Consider the merits of scale reduction for maps that are larger than page size. **Note that maps in pockets are also figures and must be numbered accordingly**.

Bear in mind that page-size illustrations are a convenience to a reader; maps and illustrations placed in a pocket are less accessible and in many cases are not examined due to inconvenience. Small is beautiful!

Only artwork for the Bulletin and Paper series publications will be prepared by the drafting office, all other final artwork is the responsibility of the author. Crudely drawn figures, that would detract from the overall quality of the publication will not be accepted and, if they are an essential adjunct to the text, may result in rejection of the manuscript.

GENERAL

Most Geological Survey Branch publications are printed in two-column format, allowing considerable flexibility in the design of illustrations. Adherence to the following guidelines will avoid problems with pagination and improve the appearance of the finished product.

- **Do not over illustrate.** Too many illustrations create a space problem, particularly with short papers. Illustrations should not swamp the text.
- Page-sized illustrations (about 9 by 7 inches) will be accepted in either horizontal (landscape) or vertical (portrait) format; vertical orientation in the final publications is, however, preferred. Half-page or column sized figures are encouraged. Plates will normally be reproduced at half-page (7 inches) or column (3.25 inches) width.
- Column-width illustrations (3.25 inches by a maximum of 9 inches) provide flexibility in page layout. They should be used wherever appropriate, particularly for charts, graphs and similar figures that do not contain a large amount of detail.
- Line drawings should be done on mylar.
- Most line drawings should be framed in a narrow border and preferably should not be **drafted at more than twice publication size**. Bear in mind that figures and plates must include a space for a caption.
- DO NOT DRAFT FIGURE NUMBERS ON ORIGINAL FIGURES – captions, including numbers, will be typeset with the text and will be centred below the figure, outside the border.
- All maps must contain a scale, north arrow and a geographic reference grid or registration points.
- Do not include geographic coordinates or similar information outside the main border of a map or illustration. This causes unnecessary reduction in the printed size of illustrations.
- All plates should be clearly identified by taping a label on the back of the photo containing the plate number and full description. **DO NOT WRITE ON THE ORIGINAL PHOTO!**
- Labels and text on illustrations should be done using the Helvetica font (*i.e.* sans serif) or equivalent. Most illustrations should be submitted larger than final reproduction size so text should be clear when reduced to page or column size. A xerox reduction of originals will give an indication of final clarity for text and line work.
- The Editor will decide the final layout and sizing of all illustrations – usually in consultation with the author.

PHOTOGRAPHS

Photographic illustrations, referred to as plates, are numbered sequentially as in the case of figures. Prints of photographs intended for publication should be submitted to the Editor unmounted, together with captions, at the same time as the rest of the manuscript. Line work or lettering that is to be superimposed on the photograph should be added only after initial editing. Normally laser-quality printing is required, text should be in the Helvetica font style. **Please consult the Editor, or the drafting staff, who will suggest lettering sizes appropriate to the final publication.**

If the photographer is not the author, appropriate acknowledgment must be made. It is incumbent upon the author to secure written permission to publish photographs owned by others, should this be necessary. Obtaining written permission is advisable if the photographer is not an employee of the Geological Survey Branch.

Points to keep in mind when selecting photographs for publication are:

- **Do not over illustrate.** Only photographs that contribute materially to the subject of the report should be used. All plates must be referred to in the text.
- Panoramic mountain views can often be used to illustrate geological points, especially if contacts or other features are highlighted, but shots of headframes, concentrators or camp sites in rolling forested country have a monotonous similarity and rarely add anything to a report.
- Photographs must be sharply focused and properly exposed. Lack of sharpness or contrast will be compounded in the printing process, generally with disastrous results. Low-contrast photographs rarely reproduce well.
- Prints must be in good condition. Cracks or the marks of paper clips cannot be removed and will be faithfully reproduced. **DO NOT WRITE ON THE BACK OF PHOTOGRAPHS; on a label or a photocopy, note the author's name, plate number, indicate which side of the picture is the top and then attach it to the back of the photo.**
- Use a bar scale on photomicrographs, rather than stating the magnification. This avoids the possibility of a misleading caption should the size be changed when the manuscript is printed (**photographs are almost always slightly enlarged or reduced during the layout and printing process to fit the page formats**).
- Indicate what cropping, if any, is required.
- Submit photos on clean, glossy stock preferably larger than final size.

TABLES

Tables present some of the most difficult editing and formatting problems in preparing a manuscript for publication. In most cases tables will be input and formatted in the publishing process. However, you may submit tables in camera-ready format – provided you follow these general guidelines and are able to produce quality, camera-ready copy from your computer system.

- Table headings and captions will always be typeset by Queen's Printer or the SRO. Do not include them within the body of the table.
- Tables should be typeset in the Helvetica or an equivalent sans serif font. Avoid bold text if possible.
- Be consistent in justifying columns of data. *i.e.* either centre, left, right or decimal justify but do not mix in the same column.
- Be consistent in column spacings.
- Standard abbreviations and chemical symbols are permitted in tables but a key should be provided as a footnote to the data.
- Appropriate linework should be used to distinguish headers, footnotes and text from the columnar data. However, do not use grids which usually only clutter the presentation.

Carefully consider presenting data graphically rather than as an extensive table. If a picture is worth a thousand words, a graph is worth a thousand tables! As a scientific author, and presumably the expert on the subject at hand, it is your responsibility to interpret and present as clearly as possible, the mass of raw data you have accumulated in the course of your research. Do not force your reader to make such interpretations!

MAPS

The Geological Survey Branch publishes both coloured and uncoloured maps, the former usually restricted to the Bulletin series. Maps published in the Bulletin, Preliminary Map, Geoscience Map, Mineral Potential and Paper series are normally drafted professionally; authors are required to do their own line work for Open Files, *Geological Fieldwork*, *Exploration in British Columbia* or other publications.

Cartography is a very time-consuming step in the publication process. Even using computer-assisted drafting techniques, it may require many months of a draftperson's time to produce large, full-colour maps. The potential for publication delays is obvious. **Authors may reduce them by submitting an AutoCad file** or a clean manuscript map that is complete and purged of errors and, by making themselves available to discuss design and layout with the draftsmen. This will minimize drafting mistakes and reduce the time required for making corrections at later stages in the drafting process.

There is really no excuse for revising maps, as opposed to correcting drafting errors, once the drafting process has begun. A cut-off point for inclusion of new data, or revision of your interpretation, must be accepted sooner or later, it should be the point at which you decide that your manuscript map is complete and ready for drafting.

One of the biggest delays in the publication process is the overall workload in the cartographic section. Maps will be drafted as soon after receipt as possible. The earlier maps are submitted the faster they will be dealt with – don't hang on to originals waiting for a slack time in drafting, it doesn't happen!

Maps and other illustrations must not contain references to other figures or illustrations. Such references can be incorporated into the caption without jeopardizing the accuracy of the final diagram.

MAP PREPARATION

Maps are often compiled at a larger scale than that of the final published map. Keep the publishing scale in mind when plotting data; do not include more detail than will be

readable when the map is reduced. The following procedure should be used when preparing manuscript maps for submission to the drafting office.

Computer plotting: Data plotted with AutoCad must be submitted on 5¼"diskette with a hard copy. Geological maps should be accompanied either by an original topographic base map on stable mylar, or as TRIM computer files (digital topographic and cultural data).

Manual plotting: Plot all geological information on a mylar base in black ink. Cultural/topographic information must be on layers separate from, but registered with, layers of scientific information. Manuscript maps on paper bases are subject to scale distortion; avoid them.

Submit a coloured paper-copy of the map and legend to the Editor, together with the mylar, to ensure accuracy in the final product.

All maps must contain a scale, north arrow, NTS sheet designation and a reference grid (UTM or lat./long.). Maps prepared in separate layers must contain registration marks to ensure correct placement of information.

SYMBOLS & TEXTURES

Use only approved symbols and abbreviations and make sure that all symbols are properly explained in the legend.(*see* illustrations of standard geological symbols)

The use of textures in most GSB map products is strongly discouraged. Textures may, however, be used to greatly enhance cartoon-style, black & white, page-size figures and diagrams. Where textures are used to clarify data they should not dominate the illustration or detract from the scientific concepts you are attempting to communicate.

TITLE BLOCKS

The title block of any map or illustration is the first contact a potential client will have with these products. It is imperative that the title be succinct and present all critical data regarding the content of the map (*see* illustration of standard title block format).

Current standards require the title block be placed in the upper, right hand corner, or alternatively in the lower, right hand corner. It must contain Provincial and GSB logos as a header, followed by a publication series number (plus a sheet number if multiple sheets are in the release) map title, NTS map number(s), authors' names in order of seniority and the map scale.

SCALE BAR

All maps must have a scale bar included as part of the title block. Due to possible expansion or shrinkage of maps in the drafting, plotting and printing processes it is not adequate to include scale in text format alone. A graphical scale bar is required fro accurate representation of scale.

AUTHOR NAMES

Authors should carefully note how they identify themselves. In particular names on maps or illustrations included in reports should be consistent with the usage on the cover of the report. All illustrations in a pocket of a report must include the author's name below the title.

LEGENDS

Although it can be argued that every geological map is unique, and that this should be reflected in the legend, the Geological Survey Branch requires a degree of uniformity in legend design.

Legends should be patterned after the Table of Formations, **listing rock units in the order of youngest to oldest, from top to bottom**. The rules of punctuation, capitalization and indentation for tables of formations are also applicable to legends. The year(s) in which the fieldwork was done is an essential part of the legend. An example of a standard legend format for a bedrock geological map is provided in Figure 7. Legend text should be submitted as word-processed files (MSWORD) on a 5¼" IBM formatted diskette; these will be incorporated into the appropriate AutoCad files.

MARGINAL NOTES

Marginal notes included on a map must be brief and convey information additional to that already provided by the map itself, or by the legend. These notes must be submitted as word processed files (MSWORD) on a 5¼" IBM-formatted diskette.

COMMON CAUSES OF DELAY

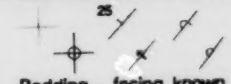
Common causes of delay in the drafting of maps are:

- The map is submitted without TRIM files, or a stable-base, topographic base map which can be used to control drafting/digitizing of georeferenced scientific data.
- Defined, approximate and assumed geological boundaries are not clearly distinguished.
- Each separate area of a geological unit is not clearly identified in conformity with the legend. Do not rely on colour alone: large areas should be identified by numbers or symbols in several places.
- The essential stratigraphic information required in the legend (period, epoch, formation name) is incomplete or ambiguous.
- Nonstandard symbols or abbreviations have been used.
- Geographical names used in the text do not appear on the map.

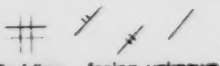
A careful review of the manuscript map, before it is

Standard Map Symbols

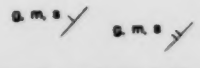
Planar Elements



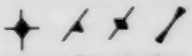
Bedding - facing known, horizontal, horizontal overturned inclined, vertical, overturned, dip unknown (arrowhead indicates proved facing direction)



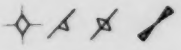
Bedding - facing unknown, (horizontal, inclined, vertical, dip unknown)



Bedding, estimated dip (gentle, moderate, steep) (facing known, facing unknown)

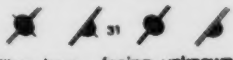


Primary flow structure in extrusive rocks (Horizontal, inclined, vertical, dip unknown)



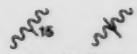
Primary flow structure in plutonic rocks (Horizontal, inclined, vertical, dip unknown)

Pillow lava - facing known (horizontal, horizontal overturned inclined, vertical + facing direction, overturned, dip unknown)



Pillow lava - facing unknown (horizontal, inclined vertical, dip unknown)

Foliation, schistosity, gneissosity, cleavage (horizontal, inclined, vertical, dip unknown) (1 - 1st generation; 2 - 2nd generation; 3 - 3rd generation etc.)

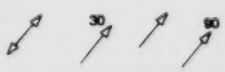


Small shear (inclined, vertical)

Joints, veins (horizontal, inclined, vertical)

Dike (too small to plot) (horizontal, inclined, vertical)

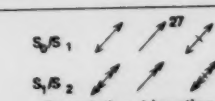
Linear Elements



Primary bedding/sedimentary Lineation (horizontal, inclined, inclined - unknown plunge, vertical)

Mineral Lineation (horizontal, inclined, inclined - unknown plunge, vertical; Sill = sillimanite)

Shape Elongation Lineation Horizontal, inclined, vertical Trend & plunge on first, second and third cleavage planes. (lineation defined by long axis of pebbles, varioles, clasts etc.)



Crenulation Lineation (Horizontal, inclined, vertical)

Slickenside striae trend & plunge

Fold Elements

Anticline & Syncline

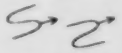
Anticline & Syncline overturned

Anticline, Syncline recumbent

Antiform & Synform (arrow indicates plunge)

Antiform & Synform overturned

Note: arrows point down dip base of 'U' points in vergence direction.



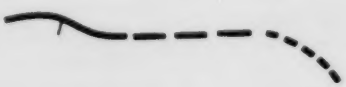
Plunge of fold axis (s-fold, z-fold)

Multiple folds 'S', 'Z' and 'M' folds (arrow indicates plunge) (inclination of axial plane known, unknown; plunge unknown)

Geological Boundaries

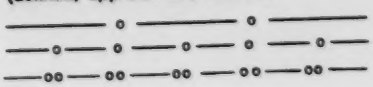
Geological Contact (defined, approximate, inferred)

Fault (defined, approximate, inferred) (inclined)



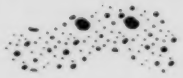
Fault (solid circle indicates downthrown side) (arrows indicate relative movement)

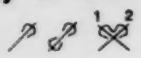
Unconformity (defined, approximate, inferred)



Thrust Fault (teeth in upper plate)) (defined, approximate, inferred)

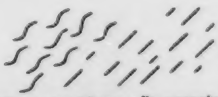
Surficial Geology & Misc.


Overburden Area



Glacial Striae
(direction of ice movement known, unknown)
(# indicates oldest relative age)

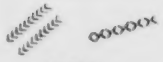
End Moraine

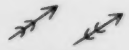

Minor moraines, rib moraines washboard moraines, 'annual moraines', till ridges transverse to ice flow (irregular, straight)

Drumlins, drumlinoid ridge crag and tail, furrow, fluting, gouge till ridge; parallel with ice flow (ice movement direction known, unknown)

Glacial flow direction (on a glacier)

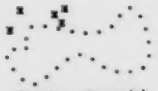
Glacial linear feature


Esker
direction of flow known, unknown


Crescentric fracture, scars chatter marks (normal, reverse)

Meltwater channels (major, minor)

Strandline(s)

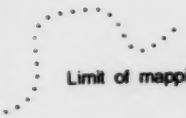

Rock outcrop(s)
Area of outcrop

Landslide (headwall scar)

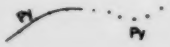
Escarpment

Volcano

Dunes


Limit of mapping

Avalanche shoot

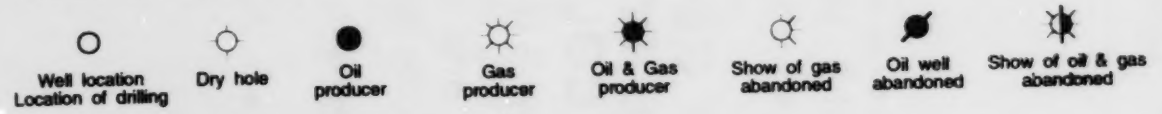


Mineralized vein, bed or seam (pyrite)

Cirque

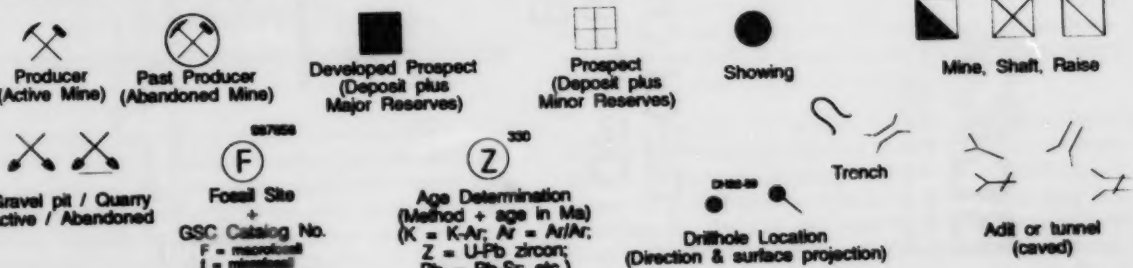
Dike, vein or stockwork defined, approximate, assumed, dip indicated

Coal, Oil and Gas

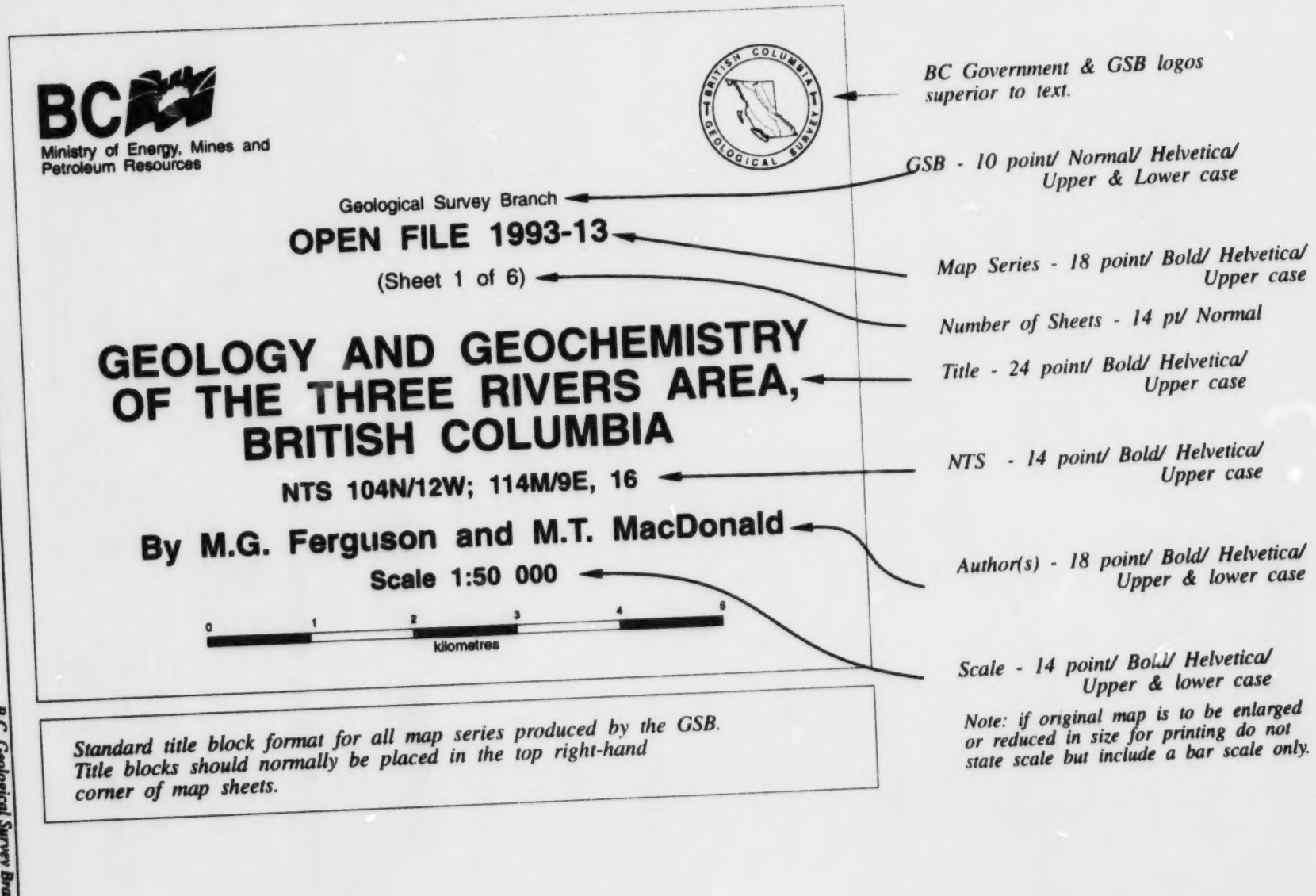


Coal seam trace (defined, approximate, assumed)

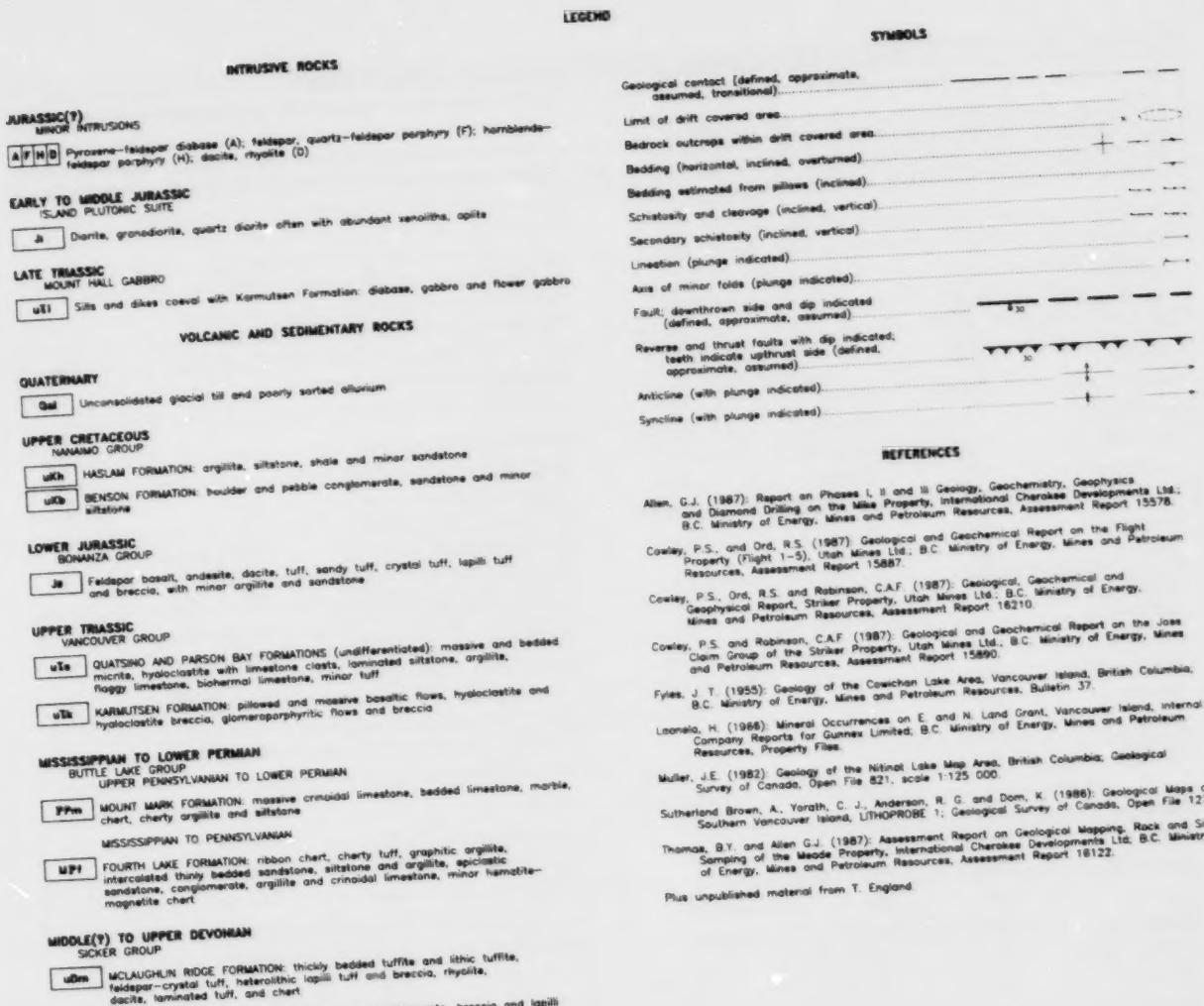
MINFILE & Mining Symbols


Producer (Active Mine)
Past Producer (Abandoned Mine)
Developed Prospect (Deposit plus Major Reserves)
Prospect (Deposit plus Minor Reserves)
Showing
Mine, Shaft, Raise
Gravel pit / Quarry Active / Abandoned
F
Fossil Site
+
GSC Catalog No.
Z
Age Determination (Method + age in Ma) (K = K-Ar; Ar = Ar/Ar; Z = U-Pb zircon; Rb = Rb-Sr; etc.)
Trench
Drillhole Location (Direction & surface projection)
Adit or tunnel (caved)

Title Block Format for Maps


BC
Ministry of Energy, Mines and Petroleum Resources
BRITISH COLUMBIA GEOLOGICAL SURVEY
Geological Survey Branch
OPEN FILE 1993-13
(Sheet 1 of 6)
GEOLOGY AND GEOCHEMISTRY OF THE THREE RIVERS AREA, BRITISH COLUMBIA
NTS 104N/12W; 114M/9E, 16
By M.G. Ferguson and M.T. MacDonald
Scale 1:50 000
0 1 2 3 4 5
kilometres
BC Government & GSB logos superior to text.
GSB - 10 point/ Normal/ Helvetica/ Upper & Lower case
Map Series - 18 point/ Bold/ Helvetica/ Upper case
Number of Sheets - 14 pt/ Normal
Title - 24 point/ Bold/ Helvetica/ Upper case
NTS - 14 point/ Bold/ Helvetica/ Upper case
Author(s) - 18 point/ Bold/ Helvetica/ Upper & lower case
Scale - 14 point/ Bold/ Helvetica/ Upper & lower case
Note: if original map is to be enlarged or reduced in size for printing do not state scale but include a bar scale only.

Standard title block format for all map series produced by the GSB. Title blocks should normally be placed in the top right-hand corner of map sheets.


LEGEND
INTRUSIVE ROCKS
JURASSIC(?)
MINOR INTRUSIONS
A F H D Pyroxene–feldspar diabase (A); feldspar, quartz–feldspar porphyry (F); hornblende–feldspar porphyry (H), dacite, rhyolite (D)
EARLY TO MIDDLE JURASSIC
ISLAND PLUTONIC SUITE
Jk Diorite, granodiorite, quartz diorite often with abundant xenoliths, aplite
LATE TRIASSIC
MOUNT HALL GABBRO
uTl Sills and dikes coeval with Karmutsen Formation: diabase, gabbro and flower gabbro
VOLCANIC AND SEDIMENTARY ROCKS
QUATERNARY
Qal Unconsolidated glacial till and poorly sorted alluvium
UPPER CRETACEOUS
NANAIMO GROUP
uKh HASLAM FORMATION: argillite, siltstone, shale and minor sandstone
uKb BENSON FORMATION: boulder and pebble conglomerate, sandstone and minor siltstone
LOWER JURASSIC
BONANZA GROUP
Jb Feldspar basalt, andesite, dacite, tuff, sandy tuff, crystal tuff, lapilli tuff and breccia, with minor argillite and sandstone
UPPER TRIASSIC
VANCOUVER GROUP
uTs QUATSINO AND PARSON BAY FORMATIONS (undifferentiated): massive and bedded micrite, hyaloclastite with limestone clasts, laminated siltstone, argillite, flaggy limestone, biohermal limestone, minor tuff
uTk KARMUTSEN FORMATION: pillowed and massive basaltic flows, hyaloclastite and hyaloclastite breccia, glomeroporphyritic flows and breccia
MISSISSIPPIAN TO LOWER PERMIAN
BUTTLE LAKE GROUP
UPPER PENNSYLVANIAN TO LOWER PERMIAN
PPm MOUNT MARK FORMATION: massive crinoidal limestone, bedded limestone, marble, chert, cherty argillite and siltstone
MISSISSIPPIAN TO PENNSYLVANIAN
MPf FOURTH LAKE FORMATION: ribbon chert, cherty tuff, graphitic argillite, intercalated thinly bedded sandstone, siltstone and argillite, epiclastic sandstone, conglomerate, argillite and crinoidal limestone, minor hematite–magnetite chert
MIDDLE(?) TO UPPER DEVONIAN
SICKER GROUP
uDm MCLAUGHLIN RIDGE FORMATION: thickly bedded tuffite and lithic tuffite, feldspar–crystal tuff, heterolithic lapilli tuff and breccia, rhyolite, dacite, laminated tuff, and chert
Dn NITINAT FORMATION: pyroxene–feldspar phyric agglomerate, breccia and lapilli tuff, massive and pillowed flows, massive tuffite and lithic tuffite, laminated tuff, and chert
Dd DUCK LAKE FORMATION: pillowed and massive basaltic flows, monolithic basalt breccias and pillow breccias, chert, jasper and cherty tuff, massive dacite and rhyolite
SYMBOLS
Geological contact (defined, approximate, assumed, transitional)
Limit of drift covered area
Bedrock outcrops within drift covered area
Bedding (horizontal, inclined, overturned)
Bedding estimated from pillows (inclined)
Schistosity and cleavage (inclined, vertical)
Secondary schistosity (inclined, vertical)
Lineation (plunge indicated)
Axis of minor folds (plunge indicated)
Fault; downthrown side and dip indicated (defined, approximate, assumed)
Reverse and thrust faults with dip indicated; teeth indicate upthrust side (defined, approximate, assumed)
Anticline (with plunge indicated)
Syncline (with plunge indicated)
REFERENCES
Allen, G.J. (1987): Report on Phases I, II and III Geology, Geochemistry, Geophysics and Diamond Drilling on the Mike Property, International Cherokee Developments Ltd.; B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 15578.
Cowley, P.S., and Ord, R.S. (1987): Geological and Geochemical Report on the Flight Property (Flight 1–5), Utah Mines Ltd.; B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 15887.
Cowley, P.S., Ord, R.S. and Robinson, C.A.F. (1987): Geological, Geochemical and Geophysical Report, Striker Property, Utah Mines Ltd.; B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 16210.
Cowley, P.S. and Robinson, C.A.F. (1987): Geological and Geochemical Report on the Joss Claim Group of the Striker Property, Utah Mines Ltd.; B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 15890.
Fyles, J. T. (1955): Geology of the Cowichan Lake Area, Vancouver Island, British Columbia; B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 37.
Leonela, H. (1986): Mineral Occurrences on E. and N. Land Grant, Vancouver Island, Internal Company Reports for Gunnex Limited; B.C. Ministry of Energy, Mines and Petroleum Resources, Property Files.
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Plus unpublished material from T. England

submitted for drafting, should eliminate these potential problems.

LINE DRAWINGS

Line drawings are an essential feature of most scientific reports, but excessive drafting demands increase costs and delay publication. Figures should supplement rather than simply duplicate information in the text. **Keep your line drawings simple and uncluttered.** Leave out details that are not needed for orientation, are not referred to in the text, or have no bearing on the point you are illustrating.

All maps require a scale bar, north arrow and a reference grid (UTM or lat/long). Use of astronomic north is preferred; if magnetic north is used, this must be indicated, together with the magnetic declination and date. **Line drawings must not include figure numbers within the artwork** nor technical data outside of borders.

Line drawings included in Bulletins and most Papers will be professionally drafted. As in the case of maps, authors can help the drafting staff, and reduce publication delays, by providing error-free drafts. **Make sure your line drawings are the way you want them before you submit them to the drafting office, not when you receive a proof.**

TABLE OF ABBREVIATIONS FOR MAPS AND FIGURES

The following abbreviations are standard GSB symbols used for consistency on maps and diagrams. Additions may be made by consulting with the Editor. For elements, *e.g.*, gold, silver *etc.*, use standard chemical symbols. You will be pleased to note that four-letter words are not abbreviated!

adularia	ad	cordierite	crd	limestone	ls	rutile	rut
actinolite	act	corundum	cor	limonite	lim		
agglomerate	agg	covellite	cv	listwanite	list	sandstone	ss
albite	alb	cuprite	cup			scapolite	scap
alunite	alun			magnetite	mag	scheelite	sch
amphibolite	amph	dacite	dac	malachite	mal	schist	shst
andalusite	adl	dickite	dk	marble	mb	scorodite	scor
andesite	andt	diopside	dp	marcasite	marc	serpentine	spt
anglesite	ang	diorite	dio	microcline	mcln	sericite	ser
anhydrite	anh	dolomite	dol	molybdenite	mo	shale	sh
ankerite	ank	dunite	dun	monazite	mz	siderite	sid
apatite	apt			monzonite	monz	silica	si
aplite	apl	enargite	en	montmorillonite	mm	sillimanite	sill
argentite	agt	epidote	ep	mudstone	mdst	siltstone	slst
argillite	arg			muscovite	mus	smithsonite	smth
arsenopyrite	aspy	feldspar	fld			specularite	spec
asbestos	asb	felsite	fls	nepheline	neph	sphalerite	sph
augite	aug	fluorite	fl	niccolite	nic	spinel	sp
azurite	az					spodumene	spod
		gabbro	gb	olivine	ol	stannite	sn
barite	ba	galena	gln	orpiment	orp	staurolite	str
basalt	bas	garnet	gnt	orthoclase	orth	stibnite	sb
bentonite	ben	glauconite	gc	orthopyroxene	opx	syenite	sy
beryl	brl	gneiss	gn			sylvite	k
biotite	bio	granite	gr	pegmatite	peg		
bismuthinite	bs	granodiorite	gd	pentlandite	pn	tantalite	ta
borax	brx	graphite	gph	peridotite	pdt	tennantite	tnt
bornite	bn	greisen	gs	phlogopite	phlo	tenorite	ten
bournonite	bo	gypsum	gyp	phosphorite	phos	tetrahedrite	tet
breccia	bx			plagioclase	plag	titanomagnetite	tmag
		halite	ha	polybasite	plb	tourmaline	tml
calcite	calc	hematite	hem	proustite	prs	trachyte	trch
carbonate	carb	hornblende	hb	pyrargyrite	pyg	tremolite	trem
cassiterite	css	hornfels	hf	pyrite	py	topaz	tpz
cerrusite	ce	hypersthene	hyp	pyrochlore	pych		
chalcedony	chal			pyrolusite	pz	vanadinite	va
chalcocite	cc	illite	ill	pyroxene	pyx	vermiculite	vm
chalcopyrite	cpy	ilmenite	ilm	pyrrhotite	po	vesuvianite	vs
chert	cht	iron formation	I-Fm				
chlorite	chl			quartz	qtz	wolframite	wf
chromite	cr	jamesonite	jm	quartzite	qtze	wollastonite	wo
cinnabar	cnb	jarosite	jr				
clinopyroxene	cpx			realgar	rlg	zeolite	ze
cobaltite	co	kaolinite	kaol	rhodochrosite	rho	zircon	zr
columbite	col	kyanite	ky	rhodonite	rhd		
conglomerate	cgl	latite	lat	rhyolite	rhy		

Line drawings for inclusion in Open File reports are the responsibility of the author. They must be drafted in black ink, preferably on mylar, and submitted in a form suitable for final reproduction. They will be printed from photo mechanical transfers (PMTs), reduced or enlarged from the originals, if necessary. The ultimate size of the figure should be kept in mind as it will influence both the amount of information that can be included, and the size of the lettering. **A proposed reduction should not be more than 50 per cent**; most drawings may be expanded a maximum of 25 per cent but the results are not usually of good quality - all glitches are magnified! The drafting supervisor is prepared to advise authors on the most effective and appropriate methods for preparing figures for reproduction.

Authors are responsible for completing the line work for all figures submitted for ***Geological Fieldwork*** and ***Exploration in British Columbia.*** The tight production schedule and the large number of papers involved precludes using professional drafting staff for this work. Authors should submit clean copy of their line work; it is preferred that labels be generated by laser printer and fixed to the mylar original. It is accepted that not all geologists are created equal, at least as far as drafting talent is concerned. Nevertheless all authors should be capable of producing line work of an acceptable standard, provided care is taken. Do not rely on the drafting staff to resurrect a botched job, they may not have time and figures that do not meet minimal acceptable standards, but are an essential adjunct to the text, may result in rejection of your paper.

DO NOT'S

- DO NOT use extra heavy borders on drawings and illustrations. We publish technical works not funeral directories. One of the most detracting aspects to a scientific paper is a heavy hand on illustration borders.
- DO NOT place text, *e.g.*, latitude/longitude, outside the main border of a map or illustration. You will lose about 20 per cent or more, of the final printed size of your illustration.
- DO NOT include figure numbers in the body of a figure. The figure number is always typeset as part of the caption. References to other illustrations must also be incorporated in the caption - not on the figure.
- DO NOT include any descriptive material in the body of an illustration which can be easily incorporated into the typeset caption.

CAPTIONS

A complete list of captions for plates and figures must be submitted with the illustrations. **Captions and figure numbers are not part of the figure**, but must be typed or typeset with the rest of the written manuscript. Ensure that all plates, tables and figures are cited in a logical sequence in the text.

If figures are reproduced from another publication, their source must be acknowledged, usually in the caption. Note the use of the following conventions:

- **After**: Possible redrafting, but no changes in the information contained in the figure.
- **Modified from**: There have been minor changes to the original figure.
- **Adapted from**: Substantial changes have been made.

The Geological Survey Branch uses the AutoCad® CAD software for cartography of geoscience maps. **The following material is a summary of the current standards used to produce geoscience maps and illustrations.** We assume you have a working knowledge of, and access to, a current version of AutoCad (Version 10 or later) to use the guidelines.

Due to the changing nature of the technology the guidelines discussed in this section are subject to revision. **Anyone preparing geoscience maps or illustrations by digital methods is strongly urged to contact the Editor or cartographic staff to confirm usage and formats.**

How To Load & Use GSB Prototype Drawing

The Scientific Review Office can supply an AutoCad diskette containing *ACAD2.dwg*, the AutoCad prototype drawing and the symbol library. These are intended as a standard from which you may generate geological maps (*see* diskette in pocket for copy of prototype drawing).

To use these standard drawing files:

- **FIRST**, copy the original *ACAD.dwg* found on your hard drive to *ACAD1.dwg* (It should be in the ACAD directory).
- Copy *ACAD2.dwg* from the floppy to your ACAD directory.
- **THEN,** copy *ACAD2.dwg* to *ACAD.dwg*.
- The GSB prototype drawing is now installed and you have a backup of your original ACAD drawing.
- Once you have the drawing up on screen, to save file space, you should purge all layers and font styles which are unnecessary to your current drawing. Save the altered purged drawing.

Cautions for Users!

- DO NOT USE THE SKETCH COMMAND TO DIGITIZE !!
- DO NOT MAKE CHANGES TO THE ORIGINAL *ACAD2.DWG* FILES

Symbols

The symbols library should be stored in a *symbols* subdirectory to the main AutoCad directory. To access any geological symbol in the library use the <insert> command, hit the <enter> key and, then type the appropriate symbol code which appears on the symbol reference sheet (*see* Figure 8).

To install the symbol library go into the AutoCad directory and create a subdirectory called SYMBOLS. Copy the file called *SYMBOLS.ZIP*, from the disk supplied by the Scientific Review Office, and then unzip the file using the PKWARE® unzip utility.

Next, edit your *autoexec.bat* file so that it contains the statement, *SET ACAD=drive letter:\ACAD386\SYMBOLS*. Reboot your computer.

AUTOCAD Settings

Units	- set angle 0=90
	- measure angles clockwise
LT Scale	- set to 0
Limits	set limits slightly larger than UTM coordinates of map sheet. *OR* lower left corner -300, -300;
	- upper right corner 1700, 1200
UCS icon	- off
Zoom	- all
Regenauto	- off
Border	- (set at Maximum drawing size for plotter)

Font Styles

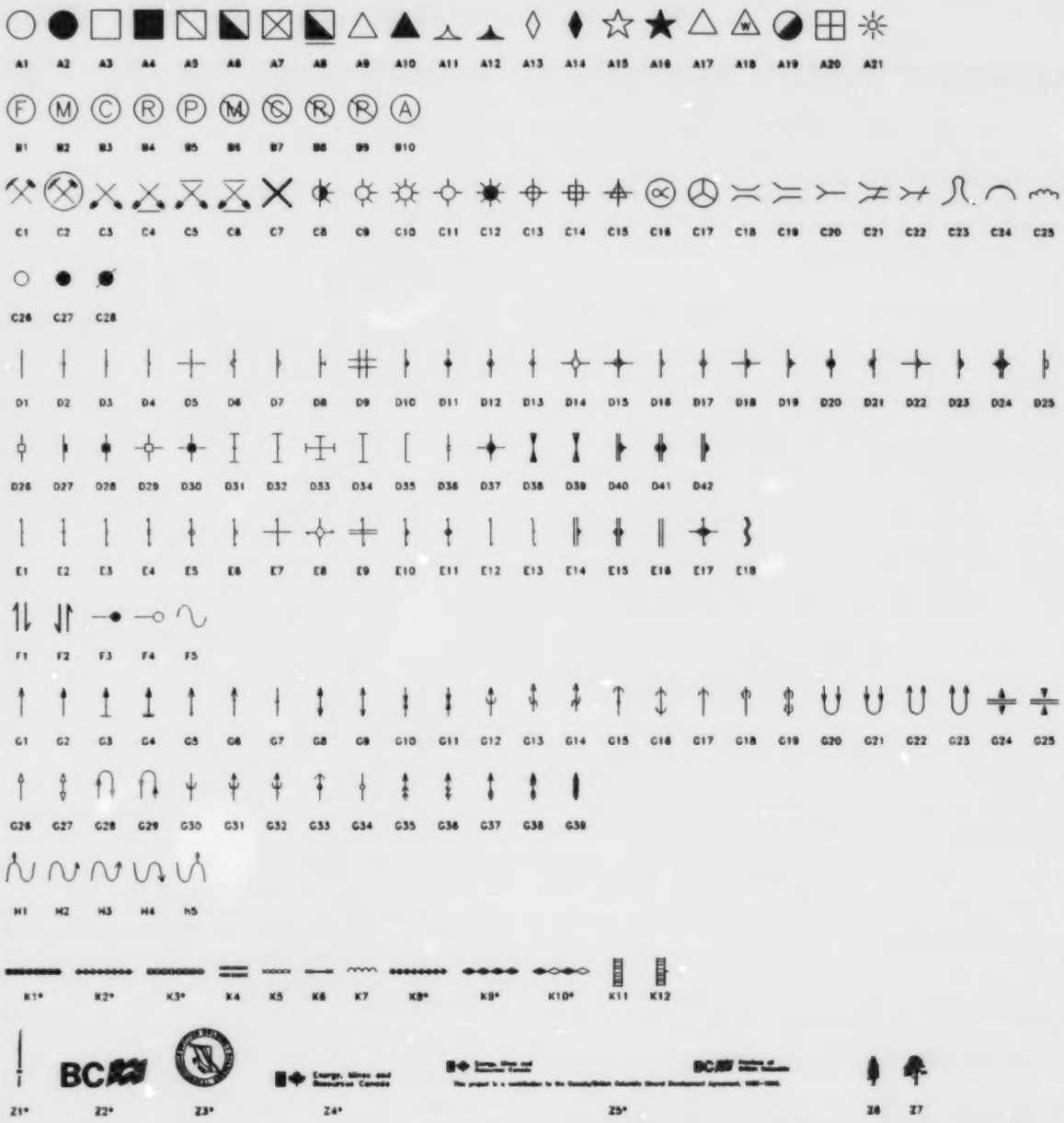
FONT FILE – The software application *X-Fonts*® is used in the cartographic office for finished products. The following are default font files used for the indicated information:(for final sizing multiply *font size* by *scale*; *e.g.*, culture on a 1:50 000 map is 2 x 50 000 = 100 000)

Geology	Roman t (use for geology, geochem, *etc.*)
Bedding	Roman s @ 1.5
Drainage	Italic c
Legend	Roman s @ 2
Title	Roman d @ 5.95
Culture	Roman s @ 2

Linetypes

The AutoCad add-on program *C-line*® is used in the cartographic office to create various linetypes.

Symbol codes for geological symbols, March 12, 1992



* For clarity these symbols have been plotted at a scale greater than one.

AUTOCAD LAYERS

This is a summary of the Layer Dictionary which follows. Main headings are layers in which general information may be placed which is not appropriate to specific layers. New layers may be created if needed but please check with cartographic unit first. **Adherence to this standardized layer system is absolutely necessary if your data is to be easily usable in the future for compilation maps, GIS systems or other applications external to AutoCad.** Also note that the illustrated hierarchy is not recognized by AutoCad *(this may vary with different versions)* but is presented in this fashion to make identification of the various data-layer options easier. DIGITAL MAPS DO NOT HAVE TO CONTAIN ALL POSSIBLE LAYERS - ONLY THOSE APPROPRIATE TO THE INFORMATION PRESENTED.

Map Layer	ACAD layer Code
CULTURE	AAcult
Claims	ABclms
Coastline	ACCstl
UTM grid	ADugrid
UTM text	AEutxt
Culture text	AFctxt
20 Contours	AG20cnt
50 Contours	AH50cnt
100 Contours	AI100cnt
500 Contours	AJ500cnt
Contour text	AKcntxt
Major rivers	ALriv1
Intermediate rivers	AMriv2
Minor rivers	ANriv3
Drainage text	AOdtxt
Lakes	APlake
Map border	AQmap
Political boundaries	ARpolit
Title-legend	AStitle
TRIM	ATtrim
Hatch patterns	AUhatch
Transport routes	AVtrans
GEOCHEMISTRY	CAchem
Chemical symbols	CBcsym
Chemical text	CCctxt
Whole rock analysis	CDwrx
GEOLOGY	GAgeol
Contacts, defined	GBcnt1
Contacts, approx.	GCcnt2
Contacts, assumed	GDcnt3
Layered contact, defined	GElcnt1
Layered contact, approx	GFlcnt2
Layered contact, assumed	GGlcnt3
Intrusive contact 1	GHicnt1
Intrusive contact 2	Glicnt2
Intrusive contact 3	GKicnt3
Dikes	GLdike
Fossils	GMfossl
Mapping limit	GNmaplm
Geochronology	GOgeocrn
Geology text	GPgeotxt
Gossans	GQgoss
Outcrops	GRocrop
Alteration	GSalter
Iosgrad 1	GTisog1
Isograd 2	GUisog2
Isograd 3	GVisog3
Isograd 4	GWisog4
MINFILE	MAminf
MINFILE symbols	MBmsym
MINFILE text	MCmtxt
Mineral potential	MDmpot
Mineral potential text	MCmptxt
QUATERNARY	QAquat
Glaciers	QBglac
Glacier text	QCgltxt
Surficial geology	QDsg
Surficial geology text	QEsgtxt
Surficial geology symbols	QFsym
STRUCTURE	SAstru
Bedding	SBbed
Foliations	SCfoil
Lineations	SDlinea
Faults1	SEflt1
Faults2	SFflt2
Faults3	SGflt3
Thrust faults1	SHtflt1
Thrust faults2	SItflt2
Thrust faults3	SJtflt3
Fold axis1	SKfaxis1
Fold axis2	SLfaxis2
Fold axis3	SMfaxis3
Anticlines	SNantic
Synclines	SOsync
UNCONFORMITIES	UAconf
Unconformity	UBucon1
Angular unconformity	UCucon2
Disconformity	UDucon3
Nonconformity	UEacon1
MISCELLANEOUS	XAmisc
Symbols	XBsym
Symbol text	XCsymtxt
Stops	XDstop
Cross sections	XEsect
Registration points	XFregis

LAYER DICTIONARY

The following presents the information which should appear on each of the standard layers. Layers are identified by their **AutoCad codes taken from the previous page**. For further information contact the cartographic staff.

AAcult	**CULTURE** - General layer containing cultural features not otherwise allocated to a layer.
ABclms	Claims - polygons identifying the boundaries of mineral or placer claims.
ACCstl	Coastline - provincial coastline.
ADugrid	UTM grid - linework representing the UTM grid in the map area.
AEutxt	UTM text - text and labels defining the UTM grid.
AFctxt	Cultural text - all text associated with cultural features; *e.g.* place names, highway numbers *etc.*
AG20cnt	Linework - 20-metre topographic contours.
AH50cnt	Linework - 50-metre topographic contours.
AI100cnt	Linework - 100-metre topographic contours.
AJ500cnt	Linework - 500-metre topographic contours.
AKcntxt	Contour text - all text associated with contour linework.
ALriv1	Major rivers.
AMriv2	Intermediate rivers or streams.
ANriv3	Minor creeks or tributaries and intermittent drainages.
AOdtxt	Drainage text - text associated with all classes of drainages.
APlake	Lakes - all polygons representing lakes.
AQmap	Map border - main administrative border defining the limits of the drafting area. Usually corresponds to NTS boundaries.
ARpolit	Political boundary - provincial, federal or international boundaries.
AStitle	Title/Legend - text and artwork related to title block, legend and summary notes.
ATtrim	TRIM - all information contained within a TRIM database used for a base map. May duplicate the type of information otherwise broken out to individual layers.
AUhatch	Hatch - separate layers for different hatch patterns.
AVtrans	Transportation - linework for roads, railways, ferry routes *etc*:
CAchem	**GEOCHEMISTRY** - general layer allocated to geochemical information.
CBcsym	Geochemical symbols - identifying geochemical sample locations or results.
CCctxt	Geochemical text - labels, text or values associated with geochemical samples.
CDwrx	Whole-rock analysis - labels and text relating to whole-rock analysis (symbols go on *Xbsym* layer)
GAgeol	**GEOLOGY** - general geological data not allocated to a specific layer.
GBcnt1	Geological contact, defined (solid line).
GCcnt2	Geological contact, approximate (dashed line).
GDcnt3	Geological contact, assumed (dotted line).
GElcnt1	Layered rock contact, defined (solid line).
GFlcnt2	Layered rock contact, approximate (dashed line).
GGlcnt3	Layered rock contact, assumed (dotted line).
GHicnt1	Intrusive contact, defined (solid line).
Glicnt2	Intrusive contact, approximate (dashed line)
GKicnt3	Intrusive contact, assumed (dotted line)
GLdike	Dikes - geological contacts identifying dike rocks.
GMfossl	Fossil - fossil locality symbols and similar data. Text related to fossils goes on *GPgeotxt* layer.
GNmaplm	Mapping limit - linework indicating extent of mapping or research.
GOgeocm	Geochronology - all geochronological data.
GPgeotxt	Geology text - all geological text, labels, formation/group identification or similar information.

GQgoss	Gossans - polygons or symbols identifying gossanous rocks (text goes on *GPgeotxt* layer).
GRocrop	Outcrops - polygons or symbols identifying location or area of outcrop.
GSalter	Alteration - polygons denoting alteration zones.
GTisog1	Isograd 1 - isograd linework for the first metamorphic category.
GUisog2	Isograd 2 - linework for the second metamorphic category.
GVisog3	Isograd 3 - linework for the third metamorphic category.
GWisog4	Isograd 4 - linework for the forth metamorphic category.
MAminf	**MINFILE** - general layer for MINFILE or mineral occurrence data.
MBmsym	MINFILE symbols - MINFILE or mineral occurrence symbols.
MCmtxt	MINFILE text - text or labels for MINFILE or mineral occurrence data.
MDmpot	Mineral potential - symbols or linework related to mineral potential or metallogenic data.
MCmptxt	Mineral potential text - text and data related to mineral potential.
QAquat	**QUATERNARY** - general layer for surficial geology data.
QBglac	Glaciers - polygons or point symbols identifying glaciated terrain.
QCgltxt	Glacial text - all text or labels related to glaciation.
QDsg	Surficial geology - polygons or linework for surficial geology.
QEsgtxt	Surficial geology text - text or labels related to surficial geology.
QFsgsym	Surficial geology symbols - all symbols related to surficial geology.
UAconf	**UNCONFORMITIES** - general layer for data pertaining to unconformable contacts of all types.
UBunconf	Unconformity - line symbols on side of younger rocks.
UCagconf	Angular unconformity - line symbols on side of younger rocks.
UDdisconf	Disconformity - line symbols on side of younger rocks.
UEnonconf	Nonconformity - line symbols on side of younger rocks.
SAstru	**STRUCTURE** - general layer for structural data.
SBbed	Structural symbols - related to bedding attitudes.
SCfoil	Structural symbols - related to foliation.
SDlinea	Structural symbols - related to lineations.
SEflt1	Faults - defined traces.
SFflt2	Faults - approximate traces.
SGflt3	Faults - assumed traces.
SHtflt1	Thrust faults - defined traces.
SItflt2	Thrust faults - approximate traces.
SJtflt3	Thrust faults - assumed traces.
SKfaxis1	Fold axis - defined.
SLfaxis2	Fold axis - approximate.
SMfaxis3	Fold axis - assumed.
SNantic	Anticlines - linework for axis.
SOsync	Synclines - linework for axis.
XAmisc	**MISCELLANEOUS**
XBsym	Symbols - all structural, geological or mining related symbols not allocated specific layers.
XCsymtxt	Symbol text - all text related to symbols on the *MAsym* layer
XDstop	Stops - invisible edges of unclosed polygon areas. These allow patterns or fills to occupy such polygons.
XEsect	Cross-sections - linework, labels and text associated with geological, geochemical or geophysical cross sections.
AFregis	Registration marks - Three or four points close to the corners and outside the map border. These points are used to register layers when they are printed separately.

SCANNING

Scanning hard copy originals is one option for recovering older, manually drawn map information. Scanning, however, should only be considered in the light of time and cost savings. If personnel and time are available it may be more cost effective to digitize data: scanning can be costly and is normally charged to the project requiring the data.

The following general guidelines are given for those who have decided that scanning is the best option for recovering valuable data:

- Discuss your job with people who have already had maps scanned. Contact the cartographic staff and scanning contractor to identify the best way to prepare your data.
- Provide as many stable-base original layers as possible. Identify the AutoCad layers you want the original data to be transferred to. *i.e.* mark each hardcopy master layer with the AutoCad layer name. (*see* list of GSB standard AutoCad layers).
- Screened originals (lines or objects) will not scan. Lines to be scanned must be clean and solid.
- Hatched areas are problematic. Manually tracing outlines of hatched areas will be done at extra cost. Scanning a pattern will also dramatically increase the size of the digital files.
- Information NOT to be scanned from the originals must be clearly marked. Note: material already in digital format, such as MSWord or dBase III^{+} ®files, should not be scanned but imported directly to AutoCad.
- Photocopy your legend and symbols and mark which AutoCad layers you want this information to be scanned to. These data should conform to the *Prototype Drawing* specifications as laid out by the Scientific Review Office. Symbols should be labelled with the block codes provided with the *Prototype Drawing* (*e.g.* B1, SS, *etc.*)
- Clearly identify four registration marks on each of the hardcopy layers to be scanned. These marks should be close to, BUT NOT AT, the four corners of the map. These marks must be at the same coordinates on all layers - UTM grid coordinates are the logical choice for these points.
- In order to provide horizontal alignment of the final map please identify two latitude/longitude points on each mylar. These should be on the same latitude line.

PEER REVIEW AND PROOFREADING

PEER REVIEW

Critical (peer) review plays an essential role in maintaining the quality of the Geological Survey Branch publications and is of increasing importance in the light of continuing demands to evaluate and monitor the effectiveness of research programs. It should be kept in mind that neither managers nor editors are necessarily qualified to scientifically review papers on specialized topics. In the absence of a formal system, it is in the author's best interests to request that his manager arrange a critical review by an appropriately qualified colleague, or alternatively that the author make suitable arrangement personally.

GSB policy requires that manuscripts submitted for publication as Bulletins must be submitted to external review before the initial in-house editing. Authors and managers should recommend potential reviewers but final arrangements will be made by the Editor. The reviewer will determine if this editing will be anonymous or not.

Scientists of the Geological Survey Branch should expect to be assigned manuscripts for peer review from time to time, as a normal part of their duties and must also expect their manuscripts to be subject to critical review. The critical reviewer should have no hesitation in questioning the scientific veracity, value of illustrations or in commenting on any apparent wordiness, or other points of style.

No manuscript should be submitted for critical review until the author considers it to be complete. Formal peer review does not take the place of peer discussion which may generate new ideas and new material.

Critical appraisal cannot be made on the basis of an incomplete manuscript.

GUIDELINES FOR REVIEWERS

It is the responsibility of author, Editor and critical reviewer to ensure that the factual information is presented clearly and concisely and in such a manner that the reader will have no doubt as to its authenticity. They may disagree on the conclusions that are drawn from the factual information, but there should be no disagreement as to the facts themselves.

The scientific community identifies all scientists with their parent organization; statements made in Branch publications therefore reflect directly upon the Geological Survey Branch. Authors are encouraged to present new hypotheses or modifications to previously accepted points of view; however, critical reviewers must ensure that such hypotheses are based on factual information contained in the manuscript. If the facts lend themselves to more than one interpretation, the alternative interpretations should be presented. Authors may indicate their support for a particular interpretation, but must give the reasons for their preference.

Major Points to be Considered by a Critical Reviewer

- Do the results presented warrant publication in the form proposed, would another mode of publication be more suitable, or is the material unsuitable for publication?
- Does the report provide any significant scientific advances or does it comprise only confirmatory data; if so, is it worth formal publication? Does it meet the objectives of the project?
- Are all the tables and figures essential; could some be omitted or combined?
- Has the author made use of material already presented in another publication; if so, has this been referenced adequately? Could any parts of the report be considered a dual publication (material presented in another Branch publication)?
- Has the author given full credit to other authors whose data and conclusions have been used in the presentation?
- Are all cited references included, appropriate and are they complete?
- Is the report too long? Is it padded? Should some of the supporting data be treated as an appendix?
- Does geophysical, geochemical, stratigraphic, geological and biological terminology meet accepted standards?
- Are the interpretations or conclusions properly supported by the data presented? Are there equally valid or perhaps better interpretations? Does the author explain why some interpretations are less acceptable than others, or why the proposed interpretation is more valid than the ones discarded?

External Review Questionnaire
B.C. Geological Survey Branch

Date Review Requested:_____ Return Due Date:____

Manuscript Author(s):_____

Manuscript Title:_____

I wish to remain anonymous to the author: yes ☐ no ☐

Reviewer Name:_____
(Please print your name as you wish it to appear in the author's acknowledgments)

Telephone:_____ FAX:_____

Guide for Reviewers:

1) Do you consider this is a major contribution to the provincial geoscience database? yes ☐ no ☐

2) This manuscript [*is*] [*is not*] acceptable for publication in the Bulletin series of publications.
(delete the unappropriate response)

3) The manuscript can be published:*(Please circle response)*
a) as is.
b) with minor revisions.
c) with major revisions & further editing.
d) should not be published (*in any format*).

4) Is the content consistent with current scientific research and/or does it deal effectively with alternate scientific views?

5) Do all parts of the manuscript warrant publication? yes ☐ no ☐
(If no, which parts should be deleted or revised?)

6) Do some parts require expansion, condensation or clarification?

7) Does the manuscript contain errors of fact, interpretation or calculation?

8) Has the author correctly cited all current and pertinent literature? yes ☐ no ☐

9) Are the content, form and presentation of figures, plates and tables suitable and necessary to the manuscript? *(Please bear in mind that you are probably working with draft versions of illustrative material)*

10) Pertinent comments not covered above:

Please attach a separate comment sheet if required. Editing may be done on the manuscript & illustrations supplied and these will be given to the author. If you wish some of your comments to remain confidential please include them in a separate letter addressed to the Editor.

Return completed form and all review materials to:

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READING & CORRECTING PROOFS

Authors have several opportunities to review their manuscripts and make corrections or revisions, the most important being the review of the first typed draft before it is submitted to the Editor.

External/Peer Review: For those manuscripts intended for publication in the Bulletin and Paper series this is the primary opportunity to test the scientific soundness of the material. All points of concern should be rectified before submitting the manuscript for in-house editing. The author must identify reasons for not incorporating valid comments from external reviewers.

Typed draft: This first draft submitted for in-house editing must be substantially complete. Minor changes should be incorporated in the manuscript as it is updated following the initial edit. Editorial comments on scientific content are suggestions intended to improve a manuscript, feel free to discuss these with the Editor; editing for style, grammar and usage is much less flexible in order to maintain consistency across a range of publications, or within larger volumes such as *Geological Fieldwork*.

It is normal that the revised manuscript will receive a second edit, after the author updates the draft before proceeding to typesetting. Normally this is a style and usage edit and is not usually returned to the author. If problems in science, structure or content are identified the author will be requested to correct the problems before further processing.

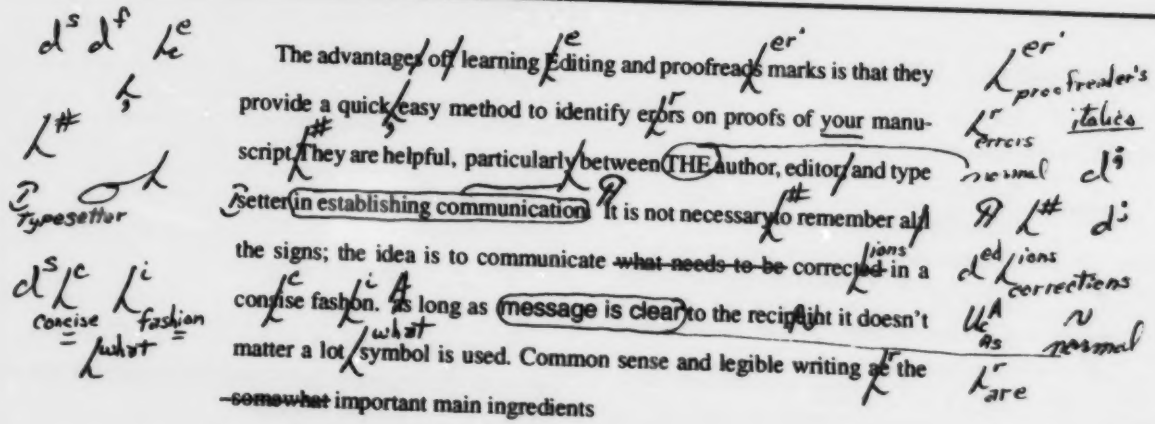
Galley: Manuscripts submitted for publication as Bulletins, and selected Papers, are typeset at Queen's Printer. Such manuscripts will result in galleys and only in exceptional circumstances will substantial revisions be accepted at the galley stage. Typesetting errors may be corrected on galley proofs but extensive revisions or addition of new material is not acceptable. In most cases both the author and Editor will review the galleys.

Page proofs: Page proofs are provided to check the placement of illustrations and captions, and to ensure that the overall layout is satisfactory. Substantial changes or revisions will not be accepted at this stage.

Note: For most Papers, Open Files and miscellaneous publications typeset using desktop publishing technology, this is the last opportunity to check your material before seeing it in print!

Blueline proofs: Blueline proofs, for Bulletins and some Papers, are provided as a **check for gross errors in the printing process, such as pages out of order or printed upside down, or mismatched captions and illustrations**; this is not an opportunity for editing unless there are scientifically critical mistakes.

Example of Text Editing Using Proofreading Marks



The advantages of learning Editing and proofreads marks is that they provide a quick easy method to identify errors on proofs of your manuscript. They are helpful, particularly between THE author, editor and type setter in establishing communication. It is not necessary to remember all the signs; the idea is to communicate ~~what needs to be~~ corrected in a concise fashon. As long as message is clear to the recipient it doesn't matter a lot symbol is used. Common sense and legible writing are the ~~somewhat~~ important main ingredients

The advantage of learning editing and proofreader's marks is that they provide a quick, easy method to identify errors on the proofs of *your* manuscript. They are helpful, particularly in establishing communication between the author, editor and typesetter.

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EDITING & PROOFING MARKS

The editing and printing staff endeavor to use standard proofing marks (*see* following illustration) when reviewing manuscripts prior to the printing process. Authors may help the Editor and printer in correcting manuscripts by using these recognized printer's symbols to mark proofs. Commonly used editing/printing marks are illustrated on the adjacent page.

Note: proofing marks should be **BOLDLY** placed in the margins of draft manuscripts to call attention to appropriate changes in text. If you edit ensure your suggestions are visible and legible. **Don't be a wimp with a red pencil!**

TABLE OF EDITING & PROOFING MARKS

Delete and Insert

- Delete
- Delete & close up
- Insert
- Insert space

Paragraphing & Position

- Move to right
- Move to left
- Move up
- Move down
- Superscript
- Subscript
- Align horizontally
- Align vertically
- Begin new paragraph
- Start a new line
- No paragraph run in
- No paragraph indent
- Transpose letters
- Transpose material in circle

Style of Type

- Wrong style of type
- Set in lower case
- Set in UPPER CASE letters
- Lower case with initial capital
- Set in small caps
- Set in TimesRoman type
- Set in Helvetica type
- Set in Italic type
- Set in Bold type
- Set in Light Face (normal) type

Punctuation

- Period
- (insert) Comma
- Semicolon
- Colon
- (insert) Parentheses
- (insert) Hyphen
- En dash
- Em dash

Miscellaneous

- Let it stand. Ignore editing.
- Spell in full
- Is this correct?

Correct grammar, punctuation and spelling are essential to good writing. The author's credibility will be quickly destroyed by grammatical errors and words misspelled or used incorrectly. Language evolves over time, but the rules of grammar and punctuation provide the framework for combining words in sentences to express thoughts and ideas without ambiguity. The title page of Bates and Jackson's *AGI Glossary of Geology* appropriately quotes Jules Braunstein as follows:

> *"It is not really a mark of distinction for a geologist's writing to be so obscure that a glossary is required for its comprehension"*

Authors should keep this quotation in mind. Scientific and technical writing requires the use of clear, concise and well-constructed sentences free of ambiguous phrases, jargon and contrived words.

It is not the purpose of this manual to provide a comprehensive guide to the rules of English grammar, but the brief notes which follow may help you to avoid some of the more common pitfalls. Subsequent sections will outline Geological Survey Branch usage with respect to capitalization, punctuation, abbreviations and related matters. Authors should keep in mind that *rules* of Branch usage are intended to maintain consistency throughout our numerous publications.

For a résumé of the basic rules of grammar, authors are referred to *Fowler's Modern English Usage* or *The Gregg Reference Manual*. For spelling and hyphenation authors are directed to the *Gage Canadian Dictionary*, and Bates and Jackson's *Glossary of Geology*, published by the American Geological Institute. The *Gage Canadian Dictionary* is the accepted guide for proper spelling of English language terms.

GRAMMAR - A FEW SIMPLE POINTS

The following points relate to problems that are commonly encountered in Geological Survey Branch manuscripts:

- Structure sentences so that related parts are as close together as possible. The following example shows how poor construction can confuse the reader:

  > The continued slump in base metal prices is predicted to have a detrimental affect on exploration in Canada by a prominent consulting geologist.

  The words *by a prominent consulting geologist* ought to follow *predicted*, in order to make it clear that it is Canadian exploration in general, not just the Canadian activities of a single consultant that are threatened.

- The subject and the verb in a sentence establish its central idea; as a general rule, they should appear early in the sentence. In the following example the subject is *outcrops of mineralized dolomite*; it should not be necessary to read to the end of the sentence before this becomes clear.

  > Northwest of Dawson Creek, close to timberline on the south-facing slopes overlooking the headwaters of the Halfway River, outcrops of mineralized dolomite occur.

  Changing the structure of the sentence changes its emphasis. If the main thrust is the geology northwest of Dawson Creek, start the sentence with this information:

  > Northwest of Dawson Creek, outcrops of mineralized dolomite occur close to timberline on the south-facing slopes overlooking the headwaters of the Halfway River.

- Failure to recognize whether the subject of a sentence is singular or plural often results in problems with verb and noun agreement. Few, if any, authors would fail to recognize the error in the sentence:

  > Geophysics *are* a difficult subject.

  but,

  > The geophysical data *is* difficult to interpret.

  is equally incorrect, data is a plural noun and takes a plural verb.

  Insertion of a qualifying clause may confuse the issue, as in:

  > Pyrite, together with silicate gangue, *is* separated from the valuable minerals by flotation.

  Pyrite is the subject of the sentence and the verb is therefore singular, however, the statement would be simpler and clearer if written with a compound subject (two nouns connected by *and*) which always takes a plural verb:

  > The pyrite and the silicate gangue *are* separated from the valuable minerals by flotation.

- Compound subjects consisting of two or more singular nouns connected by *or* or *nor* always require a singular verb. If the compound subject has both singular and plural nouns the verb should agree with the noun closest to it. Similarly when the subject contains the correlatives *not only...but also*, the verb agrees with the nearest noun. When a negative subject is joined to a positive one, the verb should agree with the positive.

  > Neither the granite nor the volcanic suite *is* affected by the earliest deformation.

  but,

  > Neither the granite nor the country rocks *are* mineralized.

and,

> Not only the intrusive rocks, but also the surrounding andesite *is* mineralized.

> Hydrothermal activity, not the affects of regional metamorphism, *has caused* the widespread chloritization seen in outcrop.

Most collective nouns (for example, *majority, number, group, quantity, series*) require a singular verb although there are times when this is technically correct but appears pedantic or foolish and it is best to rephrase the sentence to avoid the problem. Collective nouns referring to people, for example, *cabinet, committee, board, crew*, take their verb and pronoun in either the singular or plural, depending on the context. Use the singular when the group acts or thinks as a whole, the plural when referring to the actions of individuals within the group.

> All the geoscience *disciplines were* represented on the committee, nevertheless *it was* unanimous in *its* decision.

but,

> A large *crew is* based in the Highland Valley; *they work* independently in the field, comparing notes from time to time.

A singular verb is preferred with the word *government*, but whether you use singular or plural, remember the verb and pronoun must agree. A corporation is a single legal entity and always takes a singular verb; referring to companies as *they* is a common error in Branch manuscripts.

> In 1985 the government *was* concerned about the decline in exploration activity in the province and *it* responded by implementing the FAME program.

> Cream Silver Mines Limited attracted considerable publicity in 1988 when *it* drilled four holes on *its* claims in Strathcona Park.

- Although many authors argue for the use of symbols in the text of a report, to save space, some are most reluctant to use pronouns for the same purpose. A paragraph full of sentences each starting with *The andesites..., The ABC Formation..., The XYZ property...*, and similar phrases, makes very heavy reading. If you have organized your subject matter properly, the reader will not need to be constantly reminded what topic you are discussing. Pronouns such as *it* and *they* take the place of nouns; use them freely rather than repeat a noun unnecessarily.

- Always prefer concrete to abstract nouns. The sentence:

> Adverse conditions impeded travel throughout most of the period.

not only sounds pedantic but is not particularly informative. It could mean almost anything, including the fact that you failed to plan an adequate fuel supply and your truck or helicopter was continually running out of gas. Use of concrete nouns provides more specific information, as in the following examples:

> Widespread flooding throughout the summer made many roads impassable.

or,

> Morning fog hampered helicopter operations throughout the summer.

Terms implying geological processes, as *faulting, shearing, granitization, silicification, etc.* are abstract. *Faulting* cannot strike northwesterly, although *faults* or *fault zones* may.

- Similarly, **prefer active to passive verbs wherever possible**, as in:

> Mascot Gold Mines Ltd. reopened the Nickel Plate mine at Hedley in 1987.

rather than,

> The Nickel Plate mine at Hedley was reopened by Mascot Gold Mines Ltd. in 1987.

- Do not use the past tense to describe a state of affairs that still exists. If outcrops were cut by quartz veins when you made your field observations, they probably still are as you write and will be after your manuscript has been published. Use the present tense.

- Similarly, avoid language that seems to imply that natural characteristics exist only in the context of your observations, as in:

> The rock is porphyritic in thin section.

The sample, as well as the outcrop the thin section came from is also porphyritic, even though the phenocrysts may be too small to see with a hand lens.

- Sentences without adjectives and adverbs are much stronger than those overflowing with them, but are a poor vehicle for communicating complex ideas. Short, sharp sentences command attention by stopping readers dead in their tracks, but too many of them break up the flow of your writing. The choices you make in addressing this problem are a significant element of your personal style, however, geological description lends itself to overburdening sentences with adjectives and there comes a point where you should consider using two or more sentences to get your message across. If you find yourself writing something like the following example, stop!

> *The gently to moderately southwest-dipping, massive to fragmental, dark green to black, chlorite-altered, porphyritic basalts of the Massachusetts Formation cropping out north of the fault trending along the valley of Christmas Creek are cut by vertical, north-trending, auriferous quartz-carbonate-filled tension veins with extensive epidote alteration envelopes.*

All the facts may well be relevant **but this is information overload**; no single sentence should be asked to do this much work. Back up and consider how you can break up the sentence into more manageable pieces. Brevity is not an end in itself and although it may require more words, it will be worth it. Two or three sentences like this and your term as a best-selling author will be extremely short!

GENDER NEUTRAL LANGUAGE

Geological Survey Branch publications tend primarily to be technical in nature and thus usually avoid potential problems in the use of personal references. However, **the Ministry supports and promotes the use of gender-neutral language in all material, and one should guard against inadvertent use of discriminatory language.**

Luckily, many personal scientific titles are not gender specific, *e.g.* driller, Editor, geologist, engineer *etc.* At the same time authors should ensure equal billing: for example, "*Dr. Susan Smith and Jim Nabors...,*" in a correct format should be, "*Dr. Susan Smith and Dr. William Nabors...*".

Along the same lines one should keep in mind that courtesy titles such as Mr., Mrs., Miss, Ms *etc:* are gender specific. These titles are to be used very sparingly in GSB publications. It is more acceptable, particularly in North America, to **refer to individuals by their given names without courtesy titles.**

Authors should keep in mind, however, that gender-neutral does not mean the complete absence of gender specific terms, but that if they are appropriate they should be used in a balanced manner.

For further treatment of this topic please refer to the B.C. Government publication "*Gender-Neutral Language, Interim Guidelines for Government Communications*".

COMPUTER EDITING

Computer-based editing and review of manuscripts is becoming more common. All authors should be aware of the fundamental abilities of their word-processor and spell-check their material before submission for editing. Spell checkers are not infallible - they may recognize spelling but they have definite difficulty with context and usage. For example, the following material was passed without comment by our spell checker:

Off coarse, their May bee sum heir errs inn a spell cheeked dock you meant. If yore knot a ware off the con text, u ken have difficulties!

Grammar checkers may also be convenient utilities but most have very poor accuracy and problem identification rates. They may, however, bring to your attention consistent problems in style and grammar.

Absolute faith in computers is dangerous and a careful review and visual check of a completed manuscript can avoid embarrassing errors!

Note: The authors of this manual do not yet feel threatened by the above technology and live on to be the nemesis of those who ignore this Style Guide.

Correct spelling depends largely on memory. Sound is no guide to the spelling of many English words, the confusion of foreigners with such words as *rough* and *buff*; *gang* and *gangue; bough* and *cow*; *through, true, crew* and *you*; *although, sew, so* and *low, or* and *ore* and many others, is easy to understand. there are more exceptions to spelling rules than there are rules themselves. The best way of learning is to be observant when reading, but for many of us this does not seem to work and a good dictionary is the only recourse. **If in doubt, look it up**!

Dictionaries list alternative spellings for many words. A list of commonly misspelled words and Geological Survey Branch usage, where more than one spelling is technically correct, is given below. As a general rule the Canadian spelling [if there really is such an animal!] is preferred over the British or American but, as with everything else to do with this subject, there are exceptions. Primary guides to correct form are the *Gage Canadian Dictionary*, and for geological terms the American Geological Institute's *Glossary of Geology*.

Note: The Branch has purchased a site license for the *AGI Glossary of Geology* (*GEOLOGY.CMP*), and it is highly recommended that authors use it to help spell check manuscripts. It is available on computer diskette, to Branch geologists, and requires about 250K of disk space for approximately 40 000 technical terms.

Authors should be aware, however, that electronic spell checking is not a substitute for care and attention in writing and proof reading. Words may well be spelled correctly but may not be the ones you intended!

TABLE OF GEOLOGICAL SURVEY BRANCH SPELLING USAGE

Terms not included in this list will generally follow the usage of the *AGI Glossary of Geology* or the *Gage Canadian Dictionary*. Conflicts will be arbitrarily resolved by the Editor using witchcraft or equally suitable logic.

ablation
abyssal
accretionary
accommodate
acicular
acknowledgment (NOT acknowledgement)
aegirine
aerial (from the air), areal (pertaining to area)
airborne
airphoto (BUT air photograph)
alignment
alkali feldspar (no hyphen)
alkalis (NOT alkalies)
all right (NOT allright)
all-terrain vehicle
allochthonous
alluminum (NOT aluminium)
alluvial (BUT eluvial)
amygdule, amygdaloidal (NOT amygdale)
anaerobic
analogous
analyse (analysed; NOT analyze)
analysis(singular) analyses (plural)
apex (singular), apices (plural)
appendix (singular), appendices (plural)
Archean
Arctic (Canadian Arctic), arctic environment
argument (NOT arguement)
ash flow (noun, BUT ash-flow tuff)
asymmetrical
augen
augen gneiss
autochthonous
axial plane cleavage

b-axis, b-direction (BUT B-horizon)
backshore, backslope, backwash, backwater
base level, base metal (BUT baseline)
baymouth bars
bedrock (NOT bed-rock OR bed rock)
bench mark
block fault
blowout
blueprint
bore hole
bottomset
boudinage (noun NOT verb)
breakup
building stone (two words)
bunkhouse
byproduct, bypass

calcarenite
calcalkaline
calcsilicate
campground, campsite
cannot (one word)
canvas (cloth); canvass (political)
carload
catalogue (NOT catalog)
catastrophic
cave in
centre, centre point, centring
channel, channelling
channel flow
characterize (NOT characterise BUT characteristic.
clay belt (NOT clay-belt)
coalfields (NOT coal-fields or coal fields BUT coal measures)
coalbed methane (BUT the coal beds)
coal measures
coastline
coexist

collinear (NOT co-linear)
colour
(BUT coloration, colorimeter)
computer not computor
consensus
cookhouse
cooperate
Cordilleran Roundup
(NOT Cordilleran Round Up)
crossbed, crosscut, crossfault, crossfold, crosslamination
(BUT cross-section, cross-stratification)
crystallize
cutbank
cutoff

database, dataset
dating NOT age dating
damsite
datum (singular), data (plural)
defence (BUT defensive)
deflection
delimit
dependent (adjective), dependant (noun)
desiccate
desirable
dike (NOT dyke)
dip slope
disappoint
disk (for fixed storage) or diskette (for removable 'floppy' storage media (NOT disc)
discrete
disseminate
dissect
downdip, downdropped, downfaulted
downslope, downstream, downthrown
dragfold
dragline
draft (NOT draught), when referring to maps
drillhole (BUT diamond-drill hole)

embarrass
embedded (NOT imbedded)
emphasize, emphasized
enclose (NOT inclose)
encrustation (NOT incrustation)
en route (NOT enroute)
eolian (NOT aeolian)
exaggeration
existence (not existance)

fallout
fault fissure, fault scarp
(BUT fault-line scarp)
feldspar (NOT felspar)
felsenmeer
ferromagnesian
(NOT ferro-magnesian)
fetid (NOT foetid)
fieldwork
(NOT field-work or field work)
fine grained
(BUT fine-grained granite)
fireclay
fiord
floodplain
fluorite, fluorspar (NOT florite, florspar)
flow line
(NOT flow-line or flowline)
fluvioglacial (NOT fluvio-glacial)
focused
footnote
footwall
foregoing (preceding, going before); forgoing (forsaking)
foreword (preface); forward (to send forward)
freshwater (as an adjective)

gastropods (NOT gasteropods)
gauge
glacial lake
(BUT glacial-lake deposit)
glaciofluvial (NOT glacio-fluvial)
gloryhole
gold bearing (BUT gold-bearing stream)
gouge
green-grey BUT greenish grey
grey (NOT gray)
greywacke (NOT graywacke)
ground level
groundmass (NOT ground-mass or ground mass)
groundwater
guidebook
gully (NOT gulley), gullies

halfway
halo, haloes
handsample (implies it is representative)
hand specimen (NOT hand-specimen)
hangingwall
harass
hardpan, hardwood
headframe (NOT head-frame or head frame)
high-grade (adjective)
hillside (NOT hill-side or hill side)
hilltop (NOT hill-top or hill top)
hinge line
homogeneous, homogeneity
honeycomb
hoodoo
horsepower (NOT horse-power or horse power)
hostrock (NOT host rock)
hotspring
hydroelectric
ice cap, ice dam, ice sheet, ice front
(BUT icefield, iceberg)
impassable, (NOT impassible)
in situ
index, indices
incise (NOT encise)
infrared
ingoing, outgoing
inquire (NOT enquire)
instalment, installed, installation
interglacial
intertidal
interstice (noun); interstitial (adjective)
interstream
intraclast, intraformation

kame and kettle (topography)
kyanite (NOT cyanite)

labour (BUT laborious)
lakebed, lakefront, lakeshore, lakeside
landform, landmark, landslide, landmass
landlocked
large-scale (adjective)
lens (noun) (NOT lense); lenses (plural)
leucodiorite
licence (noun); license (verb)
limy (mineral makes limy, the fruit limey)
lineament
liquefaction, liquefy
listwanite (NOT listwaenite)
longshore
low-grade (adjective)

mainland
maintain (BUT maintenance)
map area, map sheet, map legend, map unit
meagre (NOT meager)
megafauna
meltwater
metadiorite, metasedimentary, metavolcanic
(BUT meta-andesite)
metre (measurement), meter (instrument)
microfauna (NOT micro-fauna)
midpoint, midsummer
milepost, milestone
millsite
mineable (NOT minable)
mineralize
mollusc (NOT mollusk)
mould (NOT mold)
motorboat
mountainside
mud boil, mud crack, mud ball, mud flat
mudflow, mudslide, mudstone
multicoloured

naphtha
nearby (NOT near by)
nearshore (NOT near shore)
nonmarine, nonglacial
northeast (NOT north-east)
BUT north-northeast

occurrence (NOT occurrance)
offshore (NOT off-shore)
oil sands
olive-green (BUT dark green)
one-half, two-thirds, three-quarters (adjectives)
onshore
opencut (BUT open pit or open-pit mine)
ordinarily (NOT ordinarly)
orient (NOT orientate)
outgoing
out-of-date (adjective)

Paleozoic (NOT Palaeozoic)
paleontology
paraffin
paragneiss, para-andesite
parallel
pebble conglomerate (BUT quartz-pebble conglomerate)
penecontemporaneous
peneplain (noun), peneplaned (verb)
per cent (NOT percent
BUT percentage)
persistent
pipeline
plateau, plateaus
platy (NOT platey)
postdate
postglacial, postmineral, postorogenic,
postmagmatic (BUT post-tectonic)
post-Paleozoic
pothole
practice (noun), practise (verb)
Precambrian
precede (go before NOT preceed)
predate
preglacial (BUT pre-Devonian, pre-existing)
proceed, (continue again)
proglacial, prograde, prodelta
program

quartzofeldspathic
quicksand

radioactive
rainfall, rainwater (BUT rain gauge)
rare-earth (adjective)
rarefy
recognize
re-cover (a land surface), recover (repair, get back)
recurrence
redbeds
reentrant
re-formed (crystals); reformed (behaviour)
relict (adjective) = residual
relic (noun) = artifact
relocate (NOT re-locate)
reopen
resistance, resistant
resume (start again), résumé (career outline)
rigour, rigorous
ripple marks, ripple bedding, ripple crosslamination
river bed, river bank, river bottom, river valley
roadbed, roadcut, roadside, roadway
rockslide (BUT rock type, rock unit)
runoff

saltwater (adjective)
sandbank, sandbar, sandspit (BUT sand dunes)
sawmill
seacoast, seafloor
seaplane, seashore, seaside, *etc.* (except sea ice, sea level)
seismic
selvage
semi-arid, semi-anthracite (BUT semicircular)
separate
severely (NOT severly)
shaly (NOT shaley)
shear zone (NOT shear-zone)
shoreline
shothole
siliceous
sinkhole
sizable (NOT sizeable)
sketch map
skis, skiing
small-diameter hole
snowbank, snowdrift, snowfall, snowfield,
snowline
steatitized (NOT steatized)
stockwork
stony (NOT stoney)
stratigraphic, stratiform, stratified (BUT stratabound)
subangular, subaerial, subarctic
subconchoidal, subcrop, subparallel
subprovince, subsurface, subunit (BUT sub-bituminous)
Stikinia BUT Stikine Terrane
sulphur, sulphide (NOT sulfur, sulfide)
supersede
supergroup, superfamily
surmise
symmetrical, symmetry

tableland
terrain (physiography)
Terrane (geological)
textbook
text figure
thin section (NOT thin-section)
thrust block, thrust fault
tidewater
timberline, treeline, trimline
topsoil
totalling (NOT totaling)
twofold

ultrabasic, ultraviolet
ultrasonic, ultramafic

undercut, underlie (NOT underly),
underestimate, underwater
updip, upslope, upstream
usable

valley bottom, valley fill, valley floor
vapour (BUT vaporize)
varicoloured (NOT vari-coloured)
vein fault, vein zone
vigour, vigorous
volume, (NOT volumn but column!)

wagon (NOT waggon)
wallrock
warehouse
watercourse, waterfall, waterfowl, waterfront,
waterline, watershed, waterway (BUT water level, water table, water well)
wavelength
whichever
whole-rock geochemistry
widespread
windfall (BUT wind gap)
worthwhile

x-ray
xenolith (NOT zenolith)

OVERWORKED WORDS

Some potentially very useful words and phrases suffer both from misuse and overwork. A few of the most commonly abused are:

altered: when attached to a mineral name to form a compound adjective, as in *chlorite-altered basalt*. There is nothing inherently wrong with *chloritized, sericitized* and similar terms. Consider using both constructions for variety. The compound is perhaps best reserved for occasions when several alteration types are linked together; *quartz-pyrite-sericite alteration* is marginally less cumbersome than *silicification, pyritization* and *sericitization* but *phyllic alteration* would be even better.

apparently: a popular hedge word and a sure sign of lack of conviction on the part of the author. If your field observations consistently indicate that the better grade mineralization in a porphyry copper system correlates with high fracture density, be forthright and say so; do not throw doubt on your own observations by qualifying them with *apparently*.

associated with: The verb *to associate* generally refers to the actions of people rather than things, but is often used in geological writing in the sense *to be often in certain company*. Do not use *associated with* as a catch-all term. High silver values may well be associated with galena mineralization, but the statement that: *Limestones are associated with faulting in the headwall of the pit*, is more accurately expressed by: *Limestones in the headwall of the pit are cut by faults*. As in the previous example, a consistent relationship between the grade of copper mineralization and stockwork development is better described as an *ore control* than merely an *association*.

common, commonly: Do not overlook the possibilities of *prevalent, frequently, often, generally* and *usually*.

comprise: meaning *consists of, encompasses, is composed of* is so useful when describing the mineralogy of rocks that it is often overworked. Consider using *consists of* or *is composed of* to avoid monotonous repetition. One may write, *The whole comprises it parts*, but the construction, *comprised of its parts*, is wrong. (*includes* is similar in meaning but infers the subject contains only some of the parts)

enhance: means *to improve the quality*, not merely increase the size.

former, latter: these words oblige the reader to look back to check the reference; a minor irritation, but something to be avoided if possible.

hence: *and so* or *it follows* usually serve the purpose equally well and are much less stilted.

horizon: one of the most abused words in the geological lexicon. A horizon is a plane and has no thickness. It is defined in geology as *an interface indicative of a particular position in a stratigraphic sequence*. In practice this definition has been stretched to include a distinctive, **very thin** bed, as in *marker horizon, ore horizon* and *soil horizon*, but to refer to a *quartzite horizon* 50 metres thick is a contradiction of terms. There are many possible alternatives, including *bed, seam, layer, band, unit* and *zone*.

host (as a verb): *Is hosted by* becomes a very tired phrase when used too often. It is best confined to descriptions of mineralization, and even then can be overdone. Consider alternative constructions using *hostrock, country rock, intruded rocks* and other variations on the theme.

initiate: means *to cause to begin*, literally *to take the initiative*. Do not use it as a substitute for *start* or *begin*. If fieldwork started in the spring, the project was probably *initiated* the previous fall, when the budget was struck.

juxtaposed: a useful word, but with more than a whiff of pedantry if overdone. Do not use it until you have considered the merits of: *placed side by side, thrust over, thrust on top of, faulted against* and similar phrases.

limited: means *restricted, confined within limits*. It has come to be used as a synonym for *sparse* or *scanty*, as in limited outcrop, and is much overworked in geological writing. Consider such alternatives as *few, sparse, meagre* and *scant(y)*.

locate: means *to discover the place where something is* or *to establish in a particular location*. Do not overwork *located* by using it as a synonym for *situated*, for example:

The claims are located on Johnny Flats

but,

The mine is situated some distance north of the creek.

observe: a much overused verb. Dictionary definitions include *to watch carefully* and *to make scientific observations*. Notwithstanding the second definition, *observation* carries connotations of a changing scene, as in whale watching or military observation. This word has an essential place in scientific writing, but do not use it merely as a fancy substitute for *seen*, as in minor structures *seen* in outcrop or grain boundaries *seen* in thin section.

occur: Frequent over use is a sign of lazy writing. Alternatives are almost always available, as in : Outcrops of andesite *occur/are found* in the creekbed; Andesites *are exposed* in the creekbed would be even better, especially if your manuscript is already well sprinkled with *occurs*.

performed: means *do* or *carry out* as in :

Exploration work was *performed* on the property by

Moosepasture Mines Ltd.

Exploration work was done on the property...

or, more simply, *Moosepasture Mines Ltd. explored the property.*, will serve equally well and is less formal.

personnel: Certainly nonsexist but a cold, impersonal word suggesting a faceless group, unheralded and uncared for. There are many alternatives including, *staff, employees, workers, crews.*

proximal, distal: These words have very specific meanings in sedimentary, volcanic, economic geology, paleontology and palnology. Do not use them when all you mean is *close by* or *far away.*

strata: Authors rarely, if ever, use *stratum* as a substitute for *bed*, but as soon as there are more than one, *strata* often finds favour over *beds*, for no apparent reason except perhaps that it sounds more learned.

that: Often **introduces a restrictive or defining clause**. However, many authors tend to overuse it and clutter their manuscripts with unnecessary restrictions. **If in doubt - leave it out!**

vicinity: *The vicinity* is defined as *the surrounding district*, a rather loose term. It is over used as a pretentious substitute for *near by* and often incorrectly as a synonym for *adjacent*, as in: Andesites *in the vicinity* of the veins are silicified. Unless the silicification is very widespread, in which case it might be better not to imply a direct relationship with the veins, the statement; Andesites *adjacent to* the veins are silicified, gives the reader much more specific information.

within: The use of *within*, to mean *inside* or *enclosed by* is technically correct but makes for somewhat stilted writing when overdone. Consider using ***in*** as a variant; linguistic purity need not always take precedence over style and readability.

volcanics, clastics, granitics, intrusives *etc.*: It may be tedious but the correct and preferred form is: *volcanic rocks, clastic rocks, granitic rocks* and *intrusive rocks*. However, as these contractions are solidly established in the science, they may be used sparingly for convenience and to add variety and reduce repetitiveness in your text.

CONTRIVED WORDS, EUPHEMISMS AND JARGON

A number of contrived words and phrases, many attributed to the jargon of computer programmer's and business school graduates, have been introduced in recent years, presumably as a badge of the author's specialization. Others are coined, often by bureaucrats and academics, under the mistaken impression that they create an aura of erudition. Some are eminently descriptive and add colour to the language, others serve no useful purpose and have no place in literate writing. A classic example occurred when a Canadian civil servant decided that the weather should henceforward be known as the *atmospheric environment*. Such a person should have been fired for mutilating the language. Readers will be able to think of many similar examples; a few are listed below.

access (as a verb): acceptable if you are talking about computer files, but not as a substitute for *reach* or *enter*, as in:

> The showings can only be *reached* on foot.

or,

> The old workings can be *entered* from below, through the drainage adit.

definitize: a redundant substitute for *define*.

download: Restrict its use to the purpose it was coined to meet, moving information from one computer system to another, usually smaller.

effectuate: Who needs it? *Implement* does the job very well.

explorationist: It can be argued that in the plural, this is a useful collective noun, covering geologists, geophysicists, geochemists, prospectors, linecutters, claim stakers, stock promoters, indeed the entire spectrum of occupations involved in exploration. However, there is certainly no need to ever refer to an *explorationist* in the singular, and one should always exercise restraint in its use.

finalize: *finish, complete, terminate* or *end* are all more precise in their meaning.

futurize: meaning *to project* or *forecast*.

input: There may be some justification for its use as both a noun and a verb in computer terminology, but *data entry* or *to enter data*, are preferred. *Input* as a noun substituting for *suggestions, ideas* or *contributions*, or as a verb meaning *to type* is acceptable in conversation but not in formal writing.

interface (as a verb): Computers and FAX machines *interface*, people communicate.

negative earnings: a contradiction of terms used to avoid forcing the reader into anything as unpleasant as thinking of losing money. This type of euphemism is popular with politicians and public relations practitioners, its purpose is to conceal or confuse and it has no place in scientific writing.

methodology: defined as *the body of methods used in a particular branch of activity*. In most cases *methods* will convey the meaning just as well.

orientate: Although this is correct usage in the British Isles no one has ever been able to explain to the writers what is wrong with *orient*. *Orientated* in place of *oriented* seems an even sillier construction.

performability: a redundant substitute for *performance*(?).

prioritize: (*priorize* is incorrect) a substitute for *set priorities* or *arrange in order*.

update: a useful verb meaning *bring up to date* has been corrupted by the computer industry and is now used as a synonym for *revise*. Information may be *updated*, manuscripts are *revised*.

weather-wise: Tacking *-wise* onto the end of words, for example, *time-wise, health-wise, money-wise, quality-wise* and numerous others, is another trademark of bureaucratic language.

METAPHORS & BUZZ WORDS

Sporting and military metaphors and other colloquial buzz words have little place in formal writing and should be used with extreme caution or not at all. They may have had considerable impact when first introduced, but have become very shopworn with the passage of time. A few of the most popular are:

deploy: meaning *to spread out* or *bring into action* systematically, has military overtones and should not be used as a substitute for *allocate*.

game-plan: meaning *business strategy* or *tactics*. The metaphor of business as a game is, to say the least, dated.

mission statement: *statement of objectives* or *mandate* sounds a little less heroic and overblown.

on-side: meaning to be in agreement with the strongest or majority position. (in the current political climate this has assumed a shady meaning of being of the right party or affiliation, or one of the team!)

players, actors: referring to participants in a business venture or negotiation.

SUBTLE JARGON

Less obvious forms of jargon abound in scientific manuscripts; some of the more common expressions that detract from the clarity of technical writing are listed in the table below. Browse through the list; you may be surprised how many old friends you will find.

TABLE OF CLUTTER & JARGON

CLUTTER	BETTER USAGE
a majority of	most
a number of	many
a percentage of	some
a large percentage of	most
accounted for by the fact	because
actual outcrops	outcrops
address the problem	face the problem
age dating	dating
along the lines of	like
along with	together with
an order of magnitude faster	ten times faster
is/are being exported	is/are exported
are of the same opinion	agree
as a consequence	because
as a matter of fact	in fact *(or leave out)*
as is the case	as happens
as of this date	today
as to	about *(or leave out)*
at an earlier date	previously, earlier
at the present time	now
at this point in time	now
based on the fact that	because
by means of	by, with
completely full	full
contributing factor	factor
currently held	held
definitely proved	proved
despite the fact that	although
due to the fact that	because
during the course of	during, while
end result	result
entirely absent	absent
fewer in number	fewer, more
first of all	first
for the purpose of	for
for the reason that	because
give rise to	cause
green in colour	green
has the capability of	can, is able to
having regard to	about
in a number of cases	often
in a position to	can, may, is able to
in a satisfactory manner	satisfactorily
in a very real sense	in a sense *(or delete)*
in case	if
in close proximity	close, near
in connection with	about, concerning
in my opinion it is not an unjustifiable assumption that	I think
in order to; for the purpose of	to
in relation to	toward, to
in respect of	about
in some cases	sometimes
in terms of	about
in the event that	if
in the vicinity of	near
in view of	because, since
in as much as	for, as
in that	as
it has been reported by Jones	Jones reported
it is apparent that	apparently
it is believed that	I think
it is clear that	clearly
it is clear that much additional work will be required before a complete understanding ...	*BE SPECIFIC!* more geochemical data is required, *etc.*
it is evident that	*(omit)*
it is of interest to note that	it is noteworthy *(or omit)*
it is suggested that	I think
it is worth pointing out in this context	note
it may be that	but
it's no big deal	*this is large and complex and will probably require a very expensive, 20-year contract!*
lacked the ability to	could not; was unable to
large (small) in size	large; small
low lying depression	depression
mineralized ore	ore
north-south trend	trends north
needless to say	*(omit - if it is, why bother to say it?)*
on account of	because
on behalf of	for
on the basis of	by
on the grounds that	because
one thing must be made perfectly clear	*a snow job is coming!*
our attention has been called to the fact	new evidence indicates
owing to the fact that	due to, because
past experience	experience
prior (subsequent) to	before; after
referred to as	called
subsequently	later
sufficient	enough
take into consideration	consider
the great majority of	most
the general public	the public
the opinion is advanced that	I think
the question as to whether	whether
there is reason to believe	I believe
this result would seem to indicate	this result shows
through the use of	by, with
ultimate	last
utilize	use
very rare(ly)	rare(ly)
was of the opinion that	thought, believed
we wish to thank	we thank
with reference to	about
with regard to	concerning
with the exception of	except
with the result that	so that

COMMONLY MISUSED WORDS AND PHRASES – A FEW TO AVOID

Using words incorrectly, or in an inappropriate context, is a common cause of ambiguity in technical writing. We are often careless and imprecise in our conversational English, but listeners can always interrupt if a point is not clear. Readers do not have this advantage. There is a comfort zone between excess colloquialism and stiff formality; where you stand within it helps define your style. Most successful writers break the rules occasionally, but this should only be done after due thought. The following list of commonly misused words and phrases is a guideline to correct usage:

accuracy, precision: *Accuracy* is a measure of how closely a measurement approaches the true value. *Precision* is the fineness of the measurement; 1 000 071 tonnes is more *precise* than 1 million tonnes but may not be more *accurate*. Avoid implying more precision than exists. Ore reserves cannot be estimated to the nearest tonne; even ore production is often only coarsely measured, by counting skips hoisted or loads trucked to the primary crusher. Precise measurement is the exception rather than the rule, especially in historical data.

achieve: implies successful effort not the mere completion of something.

aerial, areal: *Aerial* pertains to the air, as in aerial photography. *Areal* pertains to an area, as in areal reconnaissance. As both terms are used routinely in the geosciences it is important to distinguish between them.

affect, effect: *To affect* means *to make a display of* or *have an influence on*, as in:

> The experimental conditions will *affect* the results

Effect, as a verb, means *to produce*, *to bring about* or *accomplish*, as in:

> The project geologist *effected* radical changes in the drilling program.

Effect is also a noun meaning *outcome* or *result*, as in:

> The *effect* of changing the experimental conditions was disastrous.

and also as a synonym for *property*, as in personal effects.

age, age dating: The word *age* is often used unnecessarily in geological writing, as in: The granite is Cretaceous *in age*, or Isotopic *age* dating is an invaluable tool for geological interpretation. In these examples the terms can be deleted for improved clarity and conciseness. (*see* billion)

alternate: by turns: **alternative**; a choice.

and/or: This is a convenient construction which gives the reader a choice of either or both the terms separated by the solidus. However, it should be used sparingly and with some thought – in many cases it is a sign of lazy writing and can easily be eliminated!

anticipate: means *to take action in advance*, not merely to expect.

> The party chief *anticipated* the flooding and the camp was moved to higher ground.

but,

> We *expect* the helicopter to arrive before nightfall.

approximately: usually *about* can take the place of the more pretentious *approximately*. If there is any difference, *approximately* implies slightly more precision. Never use *approximately* followed by a number that has all the appearances of being very precise, as in: *approximately 7.73 kilometres* or *747 321 tonnes*.

around: on every side, NOT a synonym for *about* or *approximate*.

assay, analysis; an *assay* is usually an analysis of ore grade material. It is done to high accuracy and precision and normally uses methods specific to the metal being analyzed. An *analysis* may be done on any material but has the connotation of multi-element analysis, *i.e.* AA or ICP techniques, which **may** be less accurate than an assay only because one technique is used to identify many elements at the same time. A laboratory is usually more inclined to stand behind its assay results versus multielement analytical results – if there is a choice between the two.

bimonthly, semimonthly: *bimonthly* means occurring once every two months, as opposed to *semimonthly*, meaning twice each month. It pays to get this right in contracts!

billion: avoid using billion, in British usage it signifies 1 000 000 000 000, in North America 1 000 000 000, leading to possible confusion. (*e.g.* this is why we prefer 1143 Ma, not 1.143 Ga)

build, construct: In mining parlance, roads and buildings are built or constructed; adits, drifts, raises and crosscuts are driven ; shafts and winzes are sunk.

can, may: in formal English *can* means *know how to* or *be able to* while *may* means *be allowed to* or *have permission to*. You *can* write anything you wish but you *may* not be able to publish it!

carbonized, carbonated, carbonatized: do not confuse these terms. *Carbonized* means changed to carbon; *carbonated*, charged with carbonic acid; and *carbonatized*, replaced by carbonate minerals.

compare with, compare to: If one thing is *compared to* another, the emphasis is on their similarities. If something is *compared with* something else, both their similarities and differences are given equal consideration, and the conclusion may be that they bear little resemblance to each other. Any porphyry copper deposit might be compared with Chuquicamata, few can be compared to it.

compass directions: Use *north, south, etc.* to indicate a definite direction, as in: north bank, south boundary, northwest corner. Use *northward*, or *northerly*, when the direction is less precise. Do not duplicate compass bearings as in:

> The vein strikes **northwest-southeast**.

It is sufficient to note that **the vein strikes northwest**, to do otherwise merely creates confusion, especially if several directions are involved. Consider the sentence:

> The strike of the vein varies from northeast-southwest at its northern end, to east-west, and finally to 10 or 15 degrees north of east by south of west.

There are as many as six possible interpretations of this description. If readers have to draw a sketch to understand your description, you have failed in your purpose; if it becomes apparent that more than one interpretation is possible, they will probably put aside your paper.

comprise, include: ***Comprise* means *consists of*;** A formation is not *comprised of* conglomerate and shale, but *comprises, or consists of, or is composed of* conglomerate and shale. *Including* has a similar meaning but also implies that the list that follows is incomplete. If this is not the case, use *comprising*.

data, strata, phenomena: These are plural words if you only have one use datum, stratum, phenomenon.

definite, definitive: *Definitive* goes a step further than *definite*, introducing a note of finality. If a prospector receives a *definite* offer for his property, the terms are outlined precisely, but there may still be room for negotiation. A *definitive* offer must be accepted or rejected as it stands.

dependant, an adjective; **dependent**, a noun.

disk, diskette: computer terms which are not synonymous. *Disk* refers to a hard drive or fixed storage device. *Diskette* refers to removable media or a floppy diskette.

Early, Late; Lower, Upper: ***see* upper**

economic, economical: *Economical* means *frugal* or *thrifty* and is not a synonym for *economic* which, in geological writing signifies *profitable to extract*, and is often misused. Reporting assays as being of economic grade is meaningless unless some kind of feasibility study has been done. *Economic* **infers minable grades and tonnages have been calculated**. Many other factors in addition to grade affect the commercial viability of a prospect. During the 1970s, when open-pit mines in British Columbia with reserve grades of 0.5 per cent copper were highly profitable, the cut-off grade at Chuquicamata was 0.6 per cent.

encounter: means *to meet*, especially by chance or unexpectedly. You may encounter a grizzly bear; to say *the drift encountered the vein* gives too little credit to the geologist directing the work.

envelope, envelop: *Envelop* means *to surround* or cover completely. For example, kelphytic rims envelop kimberlitic minerals. *Envelope* is a THING that envelops, *e.g.*, magnetite was surrounded by an iron-oxide envelope.

essentially: means necessarily or indispensably. It should not be used to replace *principally, chiefly, mainly* or *mostly*.

fact: The use of such phrases as *in fact, the fact is, as a matter of fact* and *actually* suggests a lack of conviction on the part of the writer. If you find yourself using these expressions you should ask yourself whether it is you or the reader that you are trying to reassure.

factor: something that contributes to an effect, not a synonym for *circumstance, component, consideration, constituent* or *element*.

farther, implies distance; **further**, something additional, for example, farther to the north, but further evidence suggests.

fault movement: It is improper scientifically to speak of *fault movement* or how a fault moves through time. Faults do not move although there may be movement *along* a fault plane. Faults may, however, offset something.

for, of: John Jones is manager *for* a company and *of* a mine.

foreword, forward: Publications, such as this guide, may have a *foreword*. A float plane must move forward in order to take off.

frontispiece: this is a picture facing the title page of a book. It is not included in a list of plates or other illustrations.

highly, strongly, weakly: strongly is defined as *intense* or ***having a large degree of***. A rock may be ***strongly*** or ***weakly altered***; but, it cannot be *highly altered* otherwise it could also be ***lowly altered***! **Highly** infers *favourable* and geological processes should not be viewed as either favourable or unfavourable.

horizon, zone: To a soil scientist *horizon* means a layer of soil, but to a geologist a horizon is a surface with no thickness. Oil and ore don't come from horizons, no matter how often you may see the terms used in that fashion. A *zone* is a unit of rock which may be defined by thickness and extent. *Minor arsenopyrite occurs in the ore zone*.

however: Avoid starting a sentence with *however* when the meaning is *nevertheless*.

intercept, intersect: The verb *intercept* means to stop or interrupt the course of; to cut off; as in, *We intercepted the mail to the other camp. Intersect* means to cross or cut across; as in, *The drilling intersected massive sulphide.* The noun *intercept* is, of course, still valid;as in, *the intercept*

was strongly mineralized.

intrusion, intrusive: The adjective *intrusive* should not be used interchangeably with the noun, *intrusion*, for example: The granitic *intrusion* (NOT intrusive) is 15 kilometres in diameter.

literally: means *with the words taken in their usual sense*; do not use it when you mean *figuratively* or *metaphorically*.

lay, lie ; overlay, overlie: *Lay* (laid, laid) is a transitive verb – it must have an object! *e.g., I can lay the manuscript down* or, *The strong winds following the eruption laid down many centimetres of volcanic ash.*

Lie (lay, lain) is an intransitive verb – it takes no object! *e.g., Fossils lie in the shales.*

local, locally: literally, *belonging to a particular place or small area* and implies restricted distribution. Locally extensive is a contradiction of terms. Do not use *local* as a synonym for *erratic*. High-grade ore shoots are developed *locally* along the vein, implies the ore shoots are restricted in extent and much of the vein is barren or only weakly mineralized. The assay plan shows erratic high values along the vein, implies the high values are randomly distributed and there may be no significant variation in average grade along its length.

map sheet, map area: a *map area* and a *study area* are generally synonymous and may be any shape or size. A *map area* **does not become a** *map sheet*, which you can carry in your pocket, just because it corresponds with the area covered by a published map in the National Topographic Series. It may be correct to say that the geology on the map sheet is difficult to interpret, but it is a certainty that there are no outcrops in the centre of the map sheet, or any other part of it. Outcrops may occur *in* an area but information is displayed *on* a sheet. Both *map sheet* and *map area* are unhyphenated in Geological Survey Branch usage.

mineralization: as with faulting, shearing silicification, granitization *etc., mineralization*, is an abstract term implying a geological process, but its use as a concrete noun has become acceptable. Nevertheless you should always consider alternatives.

MINFILE: the British Columbia mineral deposits database. It should not be used as an adjective, as in: *There are no MINFILE occurrences in the map area.* Apart from the fact that it is grammatically incorrect (what does an occurrence of MINFILE look like?), it invites the reader to consider a whole spectrum of possibilities. Is there an intended innuendo that there are mineral occurrences in the area that have escaped the attention of MINFILE compilers, or does the author believe that MINFILE is the last word on the distribution of mineral showings in the province?

near by(adverb), **nearby**(adjective): as in, A second discovery was made while drilling *near by*, but, *Nearby* outcrops are barren.

occasionally, frequently, often: all imply time, but are often incorrectly substituted for: *in places, here and there, rarely* or *commonly*, for example: The veins are commonly (NOT often) brecciated or in places (NOT occasionally) assays exceed 20 per cent zinc.

ore: a much misused word. The definition of *ore* remains **naturally occurring material from which a mineral or minerals of economic value can be extracted at a reasonable profit**; wishing will not make it so. Ore today may not be ore tomorrow, and vice versa. It is the responsibility of government geologists to present a dispassionate view of the economic potential of mineral deposits and therefore it is particularly important they avoid abuse of the term *ore*.

ore reserves: Methods of calculating ore reserves are as varied as the definitions of the various types of reserves. **Reserve figures in Ministry publications should be quoted from industry sources – NOT calculated by Ministry staff.** However, due to differences within industry of identifying reserve categories, Ministry personnel may have to interpret in which of the following categories quoted figures should be placed:

- **Measured Recoverable**: refers to the actual tonnage of ore that may be mined. All dilution factors, cutoff grades, costs and economic/engineering factors are considered.
- **Measured Geological**: refers to *ore in situ, i.e.*, the gross reserves above a stated cut-off grade calculated from detailed sampling. No account is taken of dilution, pillars, mining costs, *etc.*
- **Indicated Ore**: tonnage and grade are computed partly from detailed sampling and partly from projection for a reasonable distance based on geological evidence. Sampling is too widely spaced to establish reliable grade-tonnage figures. Mining parameters are not considered.
- **Inferred Ore**: quantitative estimates are made in a general way only, based on geologic relationships and mining experience.
- **Unclassified:** this indicates that the criteria for qualifying the reserve figures are not available.
- **Best Assay**: this is usually the highest grade analytical result obtained from samples of various types from a property. In most cases it is geologically and economically meaningless and should not be used in GSB publications.

Please note that *mineable reserves* is a redundant construction. If something is *mineable* it is de facto a *reserve* and hence both words should not be used together.

package: means *a bundle of things or a receptacle with its contents*. It is not appropriate to describe rocks as packages and more specific and scientifically accurate terms such as unit, sequence, formation *etc.* are preferred. The Editors acknowledge, however, that this may be a convenient term if not overworked.

partially, partly: *Partially* carries implications of partiality and should not be used without first considering the claims of *partly*, for example: The feldspars are partly (NOT partially) altered to sericite.

phase: implies a temporary or short-lived condition in

a transitional or evolving process. Geological jargon includes its use as a synonym for *component*, but this should be avoided, as in: Accessory *phases* are magnetite, ilmenite, apatite and sphene. No purpose is served by substituting *phases* for *minerals*.

portion, part: *Portion* refers to a share, it should not be used interchangeably with *part*, as in:

> Get Rich Quick Mines Ltd. distributed all of its *portion* of the joint venture proceeds in the form of dividends.

but

> The joint venture agreement with Get Rich Quick Mines Ltd. applies only to the northern *part* of the property.

practical, practicable: *practical* means applicable in practice, the opposite of theoretical; *practicable* describes that which can be done.

practically: Do not use this word as a substitute for *nearly* or *almost*. It is absurd to write that a drill hole was *practically* complete when the bit was lost and the hole abandoned short of the target.

production: It is technically incorrect to say that a mine produced *x* tonnes of copper and *y* tonnes of zinc unless there was a smelter and refinery on the property and the product shipped was metal ingots. Historically most base metal mines in British Columbia have sold sulphide concentrates to a custom smelter. Mine production is calculated by multiplying concentrate grade by tonnage shipped, but the miner will not be paid in full for this amount, nor will this amount of metal actually be produced. Allowance must be made for smelting and refining losses, more significant with some metals than with others.

quite, very: meaning *to the fullest extent, without limitation*, is often incorrectly used to qualify a condition rather than establish it absolutely, as in the statement the pebbles are quite round, meaning almost round. Pebbles that are quite round should be absolutely spherical.

rapid, abrupt: It is difficult to envision the velocity of a so-called *rapid facies change* but one may commonly observe *abrupt facies changes* while scrambling over outcrops.

relation, relationship: although the meaning of both words includes a *connection*, preferred usage reserves *relations* to describe connections between people rather than things, as in *public relations, foreign relations*.

remanant, remnant: A *remnant* is a small part left over, the remainder or residue. *e.g., Mining left only remnants of the ore. Remanant* refers to that component of a rock's magnetism that has a fixed direction and is independent of moderate applied field's such as the Earth's magnetic field.

reserves (*see* ore): Ore reserves are **identified mineral resources that can be extracted profitably using existing technology and under present economic conditions**. Use of the word *reserves* implies that the deposit has been adequately sampled, its tonnage and grade calculated using accepted engineering principles, and the costs of production have been estimated, at least in a preliminary way, and suggest that extraction is economically feasible. If one or more of these criteria are not satisfied, it is more correct to use the terms *resources, mineral inventory, potential reserves* or *inferred reserves*.

responsible: Only people can be held *responsible* for events, things *cause* them. It is incorrect to say that a granite intrusion is *responsible* for the tin mineralization in the covering rocks.

scenario: an **imagined sequence of future events.** *Scenario* should NOT be used to describe an existing geological setting.

shows, exhibits: **Outcrops or rock exposures being inanimate objects cannot *show* or *exhibit* anything**. The expressions *the outcrop is iron stained*, or *the exposure contains disseminated sulphides* are preferred. Along the same lines data cannot *show* anything but data may be interpreted and conclusions reached.

somewhat: As with pregnancy, *somewhat* should not be used to describe a condition such as alteration of a rock. Either it is altered or it is not. Be more specific, by using *weakly, moderately, strongly, slightly, completely*, or some other appropriate adverb.

tends to: a much misused expression, as in: the vein *tends to* split or the strike *tends to* vary. Either the vein splits and the strike varies, or they do not.

terrain, terrane: *Terrain* is a region of the earth's surface considered in a physical sense, *e.g., The terrain was extremely rugged. Terrane* is a general term applied to a group of related rocks and the area in which they outcrop. *e.g., British Columbia is composed of numerous geological terranes, many of which are the subject of controversy.*

toward, towards: the first form is the one now generally used as a preposition.

trend, plunge; strike, dip: *linears* trend and plunge; *surfaces* strike and dip. *Southeast trending faults* is wrong.

-type, -style: *Type* and *style* are perfectly good words but are frequently ill used. Over use of these words in an attempt to create an impression of broad application for your classification may instead tend to question the reliability of your conclusions.

In most cases the addition of *-type* or *-style*, as a suffix qualifying an adjective or turning a noun into an adjective, is redundant: an *epithermal-type* system is just an epithermal system; or *porphyry-style* mineralization is just porphyry mineralization. Used after adjectives the terms can normally be deleted but there may be some justification for their use after a noun.

When discussing deposits which may be classified according to *genesis* versus *geography* one must exercise caution, *e.g., Kootenay Arc-type deposits* are not quite the same as *Kootenay Arc deposits*.

ultramafic, ultramafite: although the adjectives *clastic, volcanic* and *metamorphic* have become acceptable as nouns, they should not be used to the exclusion of the more grammatically correct *clastic, volcanic and metamorphic rocks*. Use of both constructions will introduce some variety into your writing. There seems less justification for the use of *ultramafic* as a noun when *ultramafite* already serves the purpose.

unique: means *cannot be compared* and is not a substitute for *unusual* or *rare*. If there is more than one, none are unique. Nothing can be *somewhat* or *rather* unique.

upper, lower; early, late: These terms, are not interchangeable when used in a stratigraphic sense. *Upper* and *lower* refer to stratigraphic position; *early* and *late* express age, as in:

> This distinctive unit marks the top of the *Lower* Jurassic sequence.

but,

> The limestones are intruded by *Early* Jurassic diabase dikes.

The Geological Survey Branch uses the standard time scale (developed from Harland *et al.*, 1990, Anderson, 1991 and Lumbers & Card, 1991) presented in the section on Capitalization – Geological Time, as the guide to correct usage of *early, middle* and *late* in reference to various geological epochs. This scale also presents the currently accepted subdivisions for Cordilleran stratigraphy.

values: *Value* is an abstract noun describing an attribute, not a substance. The term is so useful as a shortened form of assay value that it is generally accepted in geological writing, however, it should only be used in this sense and not without first considering possible alternatives. It may be perfectly correct to say *The assay plan shows high gold values on the 300-metre level*, but the statement, *The first drill hole intersected high gold values* is not true and is an example of flabby writing.

via: means *by way of*, not *near*.

which, that: Confusion over the correct usage of *which* and *that* is a persistent problem. *That* is properly used to introduce a restrictive clause - one that defines the noun it is attached to and cannot be omitted. *Which* introduces a nonessential clause and is usually preceded by a comma. Consider the difference in meaning between:

> The workings *that* are driven in shale are unsafe.

and,

> The workings, *which* are driven in shale, are unsafe.

The first statement implies that it is only those workings driven in shale that are dangerous, those driven in other rock types may be perfectly safe. In the second statement it is all the workings that are unsafe, the information that the wallrocks are shale is incidental. Although these are highly useful terms in the language, an excessive use of *that* is a sign of lazy writing!

with: often misused as a substitute for *and*, for *but* and a verb, or for a verb alone, as in the following examples:

> The rocks have been uplifted, tilted *and* gently folded, NOT The rocks have been uplifted and tilted, *with* some gentle folding.

> The sedimentary sequence is dominantly sandstone *but includes* (NOT *with*) some shale beds.

> The siltstone is even grained, finely laminated, well bedded *and has* (NOT *with*) clearly defined jointing.

In the third example both constructions would be better rejected in favour of: *The siltstone is even grained, finely laminated, well bedded and prominently jointed.*

CAPITALIZATION

In written English, certain words take capital letters for emphasis, and to guide the reader in much the same way as punctuation. There are rules defining which words require capitals, but modern usage allows a degree of flexibility that was not previously tolerated.

Excessive use of capitals is distracting to the reader and gives the text an unprofessional appearance. It is no longer possible to devise hard and fast rules covering all situations and the exercise of discretion is often necessary. The basic rules and usage adopted by the Geological Survey Branch are outlined here; it is essential that they be applied consistently.

SENTENCES AND LISTS

The basic rule requires a capital letter for the first word in a sentence and also applies to each item in a list written in point form, even though it may not be a complete sentence.

PROPER NOUNS

Proper nouns are capitalized, common nouns are not, but difficulty sometimes arises in making the distinction between them. Common nouns refer to everyday objects in a general sense; proper nouns refer to specific people, groups or places, or are words derived from these sources. Hence the names of months and days, many of them derived from the names of Norse and Roman gods, are proper nouns, whereas the seasons of the year have no parallel derivation and are common nouns. Proper nouns include:

- **Names of persons and places (countries, cities and place names), for example:**

Rupert Inlet	the International Boundary
Summit Lake	Vancouver Island
Highway 16	Grouse Mountain

These examples all include common nouns transformed into proper nouns because they have become part of a place name. Exercise discretion in applying this rule and avoid overuse of substitute colloquial expressions (*e.g.* the Island).

Many common nouns are used frequently in geological writing to define geographic locations, for example, trough, basin and mine. *Sensu stricto* they have become proper nouns, but to avoid excessive and repetitious capitalization, Geological Survey Branch usage does NOT capitalize *mine, basin, deposit, zone* and most other geological terms. This house rule will be expanded upon later in this section.

- **Names of months, days, holidays, Convention titles, languages, legal documents, historical period and events.**

Thanksgiving Day	the War of 1812
Order in Council 123	Cordilleran Roundup

- **Names of organized bodies**, but in most cases, only when the full name is used, for example:

the House of Commons,	the Commons
the Parliament of Canada,	Parliament,

but,

the Canadian parliament	
the Province of British Columbia,	the province
the Geological Survey Branch,	the branch

Words such as *government, legislature, ministry, branch, committee*, and position titles, are NOT capitalized unless the complete title is used, for example:

The Geological Survey Branch is organized into five sections.

but,

The branch is organized into five sections.

or,

The branch staff compiled the data.
Mapping was carried out by ministry geologists

and,

The Manager, Geoscience Information Section, is responsible for MINFILE.

but,

The manager of the Geoscience Information Section is responsible for MINFILE.

Provincial government and *federal government* do not require capitals unless used in a legal sense: for example:

The provincial government has taken numerous initiatives to stimulate resource development.

but,

The Federal Government signed a 5-year Mineral Development Agreement with the province.

but,

The Federal Government signed a 5-year Mineral Development Agreement with the Provincial Government.

- **Names of institutions, corporations and buildings.**

the Engineers Club
The University of British Columbia
Cominco Ltd.
the Douglas Building
Geological Association of Canada

GEOGRAPHICAL TERMS

- **Divisions of the earth's surface, or of a country or region.** Capitalize the names of the major divisions of the earth's surface and the names of distinct regions or political jurisdictions.

the Arctic Circle	the Atlantic Provinces
the Old World	The Pacific Coast

Note that the word *coast* is not capitalized when the meaning is shoreline, rather than a region. Also the word *province* is not capitalized unless it is followed by a proper name.

Compass points and adjectives derived from them are capitalized when they are part of a proper name established by usage, but not when they simply denote direction, for example:

Pacific Northwest

but,

northwestern British Columbia

- **Generic terms for physiographic features**. Generic terms such as *river, lake, creek* and *mountain* often form an integral part of a proper noun and are therefore capitalized, but when a plural generic term follows two or more proper names it is not; for example,

Fraser River

but,

Fraser and Thompson rivers

Generic terms that further describe names are not capitalized; hence,

the Fraser Valley

but,

the Fraser River valley

GEOLOGICAL TERMS DESCRIBING REGIONAL FEATURES

- **Cordillera**: The generic term cordillera is always capitalized when linked with a proper name:

the North American Cordillera

- **Province, Subprovince**:These terms are capitalized when used in a geological sense and preceded by a proper name, for example:

Grenville Province

- **Belt**: British Columbia is divided into five structural belts. When the generic term *belt* is used in this specific context it is capitalized as a proper noun, otherwise it is not, even when used with a proper name:

the Insular Belt **but,** the Sicker belt

- **Terrane**: The generic term *terrane*, applied to a group of rocks and to the area in which they are exposed, is not capitalized **except if preceded by a proper noun** (this term should not be confused with *terrain*).

the terrane **but,** Cache Creek Terrane

GEOLOGICAL TIME

Terms denoting geological time (*i.e.* eons, eras, periods or epochs) are always capitalized as proper nouns: for example, (*See* chart on inside rear cover for reference. *Also see* section on Stratigraphic Modifiers.)

Mesozoic Ordovician Albian

This remains true even when the time period is preceded by the prefixes *pre* or *post*; for example,

pre-Triassic pre-Ordovician but, Precambrian

STRATIGRAPHIC TERMS

Branch usage follows the general principles of stratigraphic nomenclature recommended by the North American Commission on Stratigraphic Nomenclature, **but differs in some important details with respect to capitalization**. The branch errs on the side of less capitalization, as noted below.

- **Era, period (system), epoch**: These generic terms are not capitalized, even when preceded by a proper name, hence:

Cenozoic era Recent epoch Tertiary period

- **Major stratigraphic units**: **Terrane, Supergroup, Group , Formation, Member** and **Sequence** are capitalized in Branch usage; it is assumed that nomenclature established in the literature is formalized. Although this usage is not in strict accordance with the Stratigraphic Code it provides consistency across our range of publications, particularly when individual authors cannot themselves decide if a given unit is formal or informal. Informality of any unit must be clearly stated within the text of a report andhas been it is the author's responsibility to research and indicate clearly those stratigraphic names which are informal. Used in a plural context stratigraphic nomenclature is always in lower case; for example, *Badshot and Hamill formations*.

Note: **series** is no longer used formally to describe an assemblage of groups and formations; these are now designated *groups* or *supergroups* (Article 29; Code of Stratigraphic Nomenclature).

- **Stratigraphic modifiers**: The terms **early, middle** and **late ,** referring to time, and **upper** and **lower,** referring to the position of rock units in the stratigraphic column, are only capitalized when used in **formal divisions** of the geologic time scale (*see* chart inside rear cover; after Harland *et al.*, 1990) Care must also be taken to avoid using time and position terms interchangeably, hence:

Middle Triassic sedimentary rocks
Early Jurassic isotopic dates
Lower Jurassic Telkwa Formation.

IGNEOUS AND METAMORPHIC TERMS

- **Lithodemes**: A lithodemic unit is a defined body of predominantly intrusive or highly deformed or metamorphosed rock, distinguished and delimited on the basis of rock characteristics; the fundamental lithodemic unit is a *lithodeme*. In contrast to lithostratigraphic units, lithodemic units generally do not conform to the Law of Superposition. Contacts with other units may be depositional, intrusive, tectonic or metamorphic (Article 31; Code of Stratigraphic Nomenclature). **Lithodemic terms are generally not capitalized in Geological Survey Branch usage, even when pre-**

ceded by a proper name, however, where an adjective and common noun are combined to form a proper name, both are capitalized; for example,

Nelson batholith · QR stock Moyie sills

but,

the Great Whin Sill in northern England and,
the Old Granite in the Bushveld Complex

- **Suite**: The term ***suite*** is defined in the Code of Stratigraphic Nomenclature (Article 35) as comprised of two or more lithodemes of the same class, for example, *plutonic* or *metamorphic*. The old usage of *complex* in this sense is no longer recommended, hence:

  the Shuswap metamorphic complex becomes the Shuswap Metamorphic Suite.

  and,

  Island Intrusions becomes Island Plutonic Suite.

  but,

  Coast Plutonic Complex, NOT Coast plutonic suite

  Formalized suites are treated as major stratigraphic units and hence capitalized. Informal terms, or those which are in question, will be in lower case except for proper geographic names which form part of the suite name.

- **Complex:** The Code of Stratigraphic Nomenclature (Article 37) defines *complex* as an assemblage of rocks of two or more genetic classes. It is a useful term where the mapping of each separate lithic component is impractical at normal mapping scales. For example, the term *volcanic complex* describes a site of persistent volcanic activity characterized by a diverse assemblage of extrusive rocks, related intrusions, and their weathering products. A *structural complex*, denotes heterogeneous mixtures or disrupted bodies of rock in which some individual components are too small to map, provided there is no doubt that the mixing or disruption is due to tectonic processes.

  Coast Plutonic Complex
  Metchosin Igneous Complex
  Bushveld Complex

  but,

  volcanic complex
  igneous complex
  metamorphic complex
  ophiolite complex

LITHOLOGICAL TERMS

- **Facies, phase, unit, bed:** The generic terms *facies*, *phase*, *bed* and *unit* are not capitalized when preceded by a proper name, but take a capital letter if followed by a numerical or alphabetical expression, as in:

  Tapioca sandstone unit Kotsine facies
  Bed 37 Phase B

- **Lithologic terms are not capitalized**, even when preceded by a proper name, for example:

  Reeves limestone Premier porphyry
  Bethlehem quartz diorite Besa River shale
  upper Mount Nelson dolomite

  but,

  Upper Mount Nelson Formation

STRUCTURAL AND DEPOSITIONAL TERMS

- **Fault, syncline, anticline, klippe, nappe, caldera, pipe, diatreme** *etc.*: These generic structural terms are not capitalized in Geological Survey Branch publications, even when preceded by a proper name, for example:

  Texas lineament Pinchi fault
  Cross diatreme Hall Creek syncline

- **Basin, trough, allochthon, arch, dome, arc** *etc.*: These generic terms applied to large-scale structural and depositional features are only capitalized where there is established usage in a geographical as opposed to a geological sense, for example:

  Labrador Trough Bowser Basin
  Rocky Mountain Trench Kootenay Arc
  Selwyn Basin

  but,

  Tyaughton trough Fernie basin
  Ozark dome

  It is appreciated that this rule is ambiguous; the Editor's advice to authors is, if in doubt, don't.

MINING TERMS

The Geological Survey Branch does not normally capitalize such common mining terms as **mine, mill, concentrator, shaft, raise, adit, level, drift, crosscut, pit, stope, vein, deposit, lode, zone** *etc.*, even when they are preceded by a proper name, hence:

Gibraltar mine Lornex concentrator
North shaft Boulder Creek vein
San Dionisio lode Ingerbelle pit
Montezuma adit No. 2 level

However, there are the inevitable exceptions; accepted usage requires the ***California Mother Lode***.

Common mining terms are capitalized when they are used as proper nouns; for example,

Drillhole 91-3 Level 425

PROPER ADJECTIVES

Capitals are used for proper adjectives because they are derived from proper names.

Nicol prism Douglas fir
Linnaean species Brunton compass

A proper adjective is associated with the person or place from which the adjective is derived. This association eventually becomes remote and the adjective becomes common and no longer takes a capital.

xerox copy portland cement
china clay macadam road

QUOTATIONS AND TITLES

Use a capital letter for the opening word of a quotation but not of quoted phrases.

> Smith writes, "The high-grade ore contains gold nuggets the size of match heads."

but,

> Smith reports the presence of nuggets the size of match heads.

HYPHENATED COMPOUNDS

A proper noun or adjective in a hyphenated compound retains the capital. Prefixes are capitalized when they are part of a specific name.

inter-American
Anti-Lebanon Mountains Trans-Canada Highway

THE WORD *THE*

Capitalize the word *The* when it is part of a legal name.

The University of British Columbia
The Royal Trust Company
The Hague

TRADEMARKS, COPYRIGHTED TERMS

A trade name or copyrighted term is the name under which a company does business or sells its services. These are proprietary and are protected by law and usually capitalized. Occasionally popular usage (or miss-usage) may reduce it to a common noun (*e.g.*, a xerox copy)

Lectra Haul Wabco
Dräger Honda
MINFILE

GOVERNMENT ACTS

All acts and regulation titles are capitalized and should be typed exactly as published. Acts are italicized in phototypesetting; for example,

Mineral Tenure Act

CLAIM NAMES

Claim names are proper nouns and therefore capitalized.

Tyee Ruth Vermont Firestorm

PUNCTUATION

Punctuation organizes your ideas and makes their meaning clearer to the reader; punctuation that does not serve this purpose is redundant. **Avoid the tendency to over punctuate.**

The following common punctuation marks are recognized in written English: **period, colon, semicolon, comma, dash, question mark, exclamation mark, quotation marks, parentheses and brackets, apostrophe, solidus, ellipses, asterisk, crosshatch, dagger and ampersand.** They are conventional signals to your readers and you must know what marks are customarily used to indicate the relationship you wish to express. Be aware that the position of punctuation marks within a sentence can change emphasis and meaning dramatically.

APOSTROPHE (')

The apostrophe is used:

- To indicate the possessive. Use it alone on words ending with an *s* or *z* sound, with an *s* in other cases. Note that this rule covers its use with plural nouns and with proper names ending in *s*.

  The mine's production capability...
  The provinces' desire for unified action....
  (several provinces)
  The province's desire to act unilaterally....
  (one province)
  Jones' paper on isotopic dating....

The apostrophe is omitted in cases where the word is not used in a truly possessive sense.

The Prospectors and Developers Association...

or,

...several minutes delay...

- To indicate the omission of letters or numerals.

  ... they're best passed over...

  The Trail of '98

Contractions are not normally used in formal writing. Be sure to distinguish between *it's*, the contraction of *it is*, and *its*, the possessive pronoun, which does not take an apostrophe.

COLON (:)

The colon is a valuable punctuation mark but often neglected, perhaps because relatively few writers know how to use it properly. It indicates a break in the train of thought that is shorter than a period, but longer than a semicolon. It is used:

- To separate two contrasting ideas in a single sentence – an elegant alternative to the overused phrases, *on the other hand, in contrast* or *in comparison;* for example,

  The andesites are strongly altered: the diabase sills show no evidence of alteration.

- To introduce a formal statement, or a statement that enlarges on the one that precedes it. In this case the colon acts as a substitute for *like* or *that is to say* or *therefore*.

  The diabase sills are unaffected by hydrothermal alteration: they are clearly younger than the mineralizing event.

- To introduce a series of particulars such as a list.

  Diagnostic features of late-stage veins are: the absence of carbonate gangue, textures typical of open-space filling, an abundance of marcasite, and high silver:gold ratios.

- Before a final clause that summarizes what has gone before.

  The target is a strong electromagnetic conductor of short strike length, with coincident magnetic and gravity anomalies and down-ice dispersion of anomalous copper and zinc in basal till: in short, it has all the attributes of a suboutcropping massive sulphide deposit.

- To identify a ratio of chemical elements without a specific value (*also see* Abbreviations and Symbols); for example,

  The Au:Ag ratio is consistent throughout the formation.

but use a solidus if quoting a value; as in,

The Au/Ag ratio is 0.137.

DO NOT USE A COLON:

- Before a list if the items are in apposition to an introductory word.

  Numerous byproduct metals are recovered from porphyry copper deposits in British Columbia, such as: gold, silver, molybdenum and germanium.

  WRONG: The colon should be omitted.

- Before an indirect question or quotation.

  The problem is: How to distinguish the two granitic phases in the field.

WRONG: The colon and the word *How* should be omitted.

COMMA (,)

The comma is the workhorse of punctuation marks. Modern practice favours using commas with restraint. Use them only if it makes the meaning clearer. Unnecessary commas are worse than commas left out. Overuse (close punctuation) often results in jerkiness without clarification; **the Geological Survey Branch leans toward using the minimum punctuation necessary for clear understanding** (open punctuation). Examples of close and open punctuation are:

close,

> The limestone, which, in places, overlies the crystalline basement, is, for the most part, deeply weathered and poorly exposed.

open,

> The limestone, which in places overlies the crystalline basement, is for the most part deeply weathered and poorly exposed.

Commas are used in a variety of situations. The most common uses in technical writing are:

- To separate the elements of a series. When a conjunction is used between the last two elements, omit the comma. A test of whether a comma is appropriate to separate a series of qualifying adjectives is to substitute *and* for the comma; if the meaning is unchanged, a comma may be justified, but avoid commas that separate closely related nouns and adjectives.

  > The basal unit comprises sandstone, siltstone, shale and a few thin limestone beds.

  but,

  > The coarse-grained fossiliferous sandstone is....

- To mark off nouns or phrases in apposition.

  > Good drilling conditions are usually indicative of weak mineralization; the converse, slow drilling and poor core recovery, is characteristic of high-grade sections.

Appositives preceded by *or*, are always set off by commas.

> Sphene, or titanite, is a monoclinic mineral of the epidote family.

- To mark off most parenthetical expressions (*e.g.* however, for instance, on the other hand, I think). In many cases the parenthetical expression should be omitted, as in the following two sentences.

  > A raise is driven from below; a winze, on the other hand, is sunk from above. Needless to say, when completed they cannot be told apart.

  Apply this rule with caution. If a pause is not required when reading aloud, omit the comma. For example, after *therefore* in the following:

  > The better grade ore is too deep to be mined in an open pit, therefore block caving methods will be used.

- To mark off nonrestrictive phrases and clauses; that is subordinate clauses or phrases that can be left out without changing the sense. Omission of a restrictive clause would destroy the meaning of the sentence.

  Restrictive subordinate clause – no comma:

  > Granite is a coarse-grained igneous rock which contains at least 10 per cent quartz and 65 per cent potash feldspar.

  Nonrestrictive subordinate clause – set off by comma,

  > Granite, which is often used as an ornamental stone, contains at least 10 per cent quartz and 65 per cent feldspar.

- To set off adverbs and adverbial phrases that modify a whole clause.

  > Once again, British Columbia's gold production has become a significant factor in the world scene and investors are reevaluating the province's precious metal potential.

- Between titles and degrees used with names.

  > John Jones, M.A., Ph.D., F.G.S.

- To mark off an address or date.
  (*each item after the first two*).

  > On November 15, 1907, the spur line was completed and the first shipments of concentrate were made to the Tacoma smelter.

  but,

  > In November 1907, the spur line....

- To separate two words or numbers that might otherwise be misunderstood.

  > By the time the mine closed in November 1914, 350 000 tonnes of ore had been milled.

- To mark off a contrasting expression introduced by *not*.

  > Herbert Hoover is well known, not as a mining engineer but as President of the United States at the time of the 1929 Crash.

- Rarely, to avoid repetition of a phrase; as in,

  > Biotite is the dominant phenocryst in the post-ore dikes; quartz, in the mineralized stock.

- **To avoid ambiguity**, even in cases where no specific rule justifies the use of punctuation; as in,

  > Hours before, the helicopter arrived to move the drill.

  rather than,

  > Hours before the helicopter arrived to move ...

* * *

- **Commas ARE NOT used before the conjunctions *and* or *but* except when they are used to isolate restrictive phrases and clauses.**

DASH (–)

The dash is a useful punctuation mark but often overworked. **An excess of dashes is a mark of an amateur and they should be used sparingly in technical writing.** When used, dashes are preceded and followed by a space. These spaces are frequently forgotten, resulting in confusion with hyphens; as in the following example,

> Previous work left an unmapped strip centred on the Taseko Lakes–Lord River watershed.

As written, *Lakes* appears to be hyphenated with *Lord*; use of a dash, with spaces on either side, will avoid this problem. Unfortunately for most word processors computer keyboards do not have a dash, this makes it doubly important not to forget the spaces. Dashes are also used:

- As a substitute for parentheses. A pair of dashes sets off material in parenthesis more decisively than a pair of commas, and gives it emphasis.

  > Thin-bedded argillaceous units – Earn slates and the Kechika Group – are intensely strained.

- Before a clause that sums up the earlier part of the sentence; as in,

  > Lapilli and ash-fall tuffs, laharic breccias, agglomerates – every product of an explosive eruption is exposed in the canyon walls.

The dash is **NEVER** used after a colon, semicolon or comma.

DOUBLE PUNCTUATION

Double punctuation is used only with abbreviations, quotation marks, parentheses and brackets. Difficulty sometimes arises over the order of punctuation in these circumstances. Simple rules are:

- The period marking an abbreviation always comes first; if the abbreviation is at the end of a sentence, a second period is not required.
- With parentheses and brackets, if the parenthetical material is a complete sentence, use a period inside the parentheses; if it forms only part of a sentence, no punctuation is required before the closing parenthesis or bracket unless a question is implied, in which case a question mark is placed before the closing parenthesis.

  > Most geologists classify these deposits as volcanogenic [Brown (1946) disagrees with this interpretation.] and unrelated to the nearby granite.
  >
  > These deposits (although spatially associated with granitic intrusions) are classified as volcanogenic by most geologists.
  >
  > Old reports speak of direct-shipping ore, grading several ounces of gold per ton; however, it seems probable that there was some upgrading (hand cobbing or simple gravity separation?) before the ore was shipped.

For the practice with quotation marks, refer to that section on the following page.

EXCLAMATION MARK (!)

The exclamation mark denotes an expression of strong or sudden emotion. **It should always be used with restraint and seldom, if ever, in scientific writing**. Enclosed in parentheses, it is occasionally used to indicate irony, but this application is not recommended.

PARENTHESES ( ) AND BRACKETS [ ]

Parenthesis means literally *an insertion beside*; something **outside the essential meaning of a sentence**. Parenthetical material provides additional information to the reader, as an *aside*, and the sentence should be logically and grammatically complete without its inclusion. However, as an author you should exercise your imagination and try to include such material by rewording, or perhaps by using the lowly comma. Excessive use of parenthesis detracts from the flow of information and ideas – like driving a car down a railway – you'll get to your destination but it'll be a rough ride.

Parentheses are used:

- To indicate something that is indirectly related to the thought of the sentence, but not actually connected with it by construction.

  > The volcanic facies consists predominantly of green, pyroxene-bearing volcaniclastic rocks (including chlorite schist and heterolithic breccia) with subordinate andesite flows.

- To set off incidental explanations or comments, or an afterthought.

  > The volcanic facies (first recognized by Johnson in the type area 50 km to the west) here consists almost entirely of pillowed andesite flows with only a very minor volcaniclastic component.

- To enclose letters or numbers designating a series of points: (a), (b), (c); (1), (2), (3).
- To enclose references to figures and plates, citations of publications listed in the References, and other information required by the reader, but not an essential part of the text; for example, *(see* Chapter 7), (Figure 3-23), (Hynes, 1959).
- As a part of formulae to clarify associations.

- To enclose synonyms or slang terms of text material. It is not necessary to enclose text in double or single quotes if it is already separated by parentheses.

Brackets are used:

- To enclose comments inserted into a quotation (*see* Quotation Marks).
- To enclose material inserted into the text by an author or Editor.

  The President of Teck Corporation recently drew attention [*see* address by N.B. Keevil Jr. to 1988 Mineral Resources Conference in Ottawa] to Canada's rapidly declining base metal reserves.

- To enclose parenthetical material which itself contains information in parentheses.

  [*see* Section 123 (a) (ii) of the act]

PERIOD (.)

The period is the most important punctuation mark. It is used:

- To mark the end of a sentence that is neither a question nor an exclamation.
- To mark an ellipsis (something left out of the text). Three periods are used if the omission is in the middle of a sentence; four if it is at the end. This device is commonly used in quotations where only a partial sentence is needed to support your point; for example,

  "Auriferous quartz veins... are found only within the Cache Creek Group.""

  The text omitted gave details of the elemental association in the quartz veins, information that may not be relevant if your purpose is merely to illustrate that only the Cache Creek rocks are prospective for gold.
- After an abbreviation. Do not omit this period, even when it is followed immediately by a mark of sentence punctuation, **except at the end of a sentence**.

  Two prospectors, financed by Grubstake Mining Co. Ltd., made the initial discovery.

The period is **NOT** used:

- After display lines, in titles and subheadings.
- After box headings in tables.
- After date lines and signatures.
- After contractions (as opposed to abbreviations), for example: *cont'd, didn't* – a situation that will not normally arise in scientific writing.

QUESTION MARK (?)

The question mark is used:

- At the end of a sentence that is a direct question.
- After every direct question in a series that makes up a single sentence.

  The software program prompts the user by asking: What is the map reference? the name of the property? the record date? the registered owner?

- Enclosed in parentheses to express doubt about the correctness of the preceding statement. Note that a space always precedes (?). This application is very useful, particularly in scientific writing, but is often overdone. There are many other ways of expressing doubt; as in the following example,

  The alteration assemblage includes quartz, kaolin, muscovite and dumortierite (?).

  But this could equally well be written as:

  The alteration assemblage includes quartz, kaolin, muscovite and possibly dumortierite.

  Question marks in parentheses are commonly used in fossil identification to clarify the reliability of the data presented. This usage is detailed in the chapter on Special Punctuation and Formatting which follows.

- A question mark is **NOT** used after indirect questions or if the sentence, although technically a question, is actually a request; as in,

  Will you please forward assay results no later than next Thursday.

QUOTATION MARKS (" ") (' ')

Double quotation marks are used to enclose a direct quotation, written or spoken. The material inside quotation marks must follow the phraseology, spelling and punctuation of the original in every detail, even to the extent of reproducing errors (although these may be indicated by inserting the Latin *sic* in brackets, immediately following the error). Any other interpolated matter not in the original must also be enclosed in brackets; as in,

Robinson (1909) notes, "Rocks of the Matlock Series [the Belper Group in current usage] are exposed in small isolated windows through the Triassic cover."

- When a quotation is broken into two parts, as in written dialogue, two pairs of quotation marks are needed. It is unlikely that this situation will arise in technical writing.
- When a quotation comprises two or more consecutive paragraphs, use quotation marks at the beginning of each paragraph and at the end of the last one.
- In cases where quotations occur within quotations, dou-

ble quotation marks are used for the main quotation, single ones for the internal quotation.

- Titles of articles, essays and chapters are placed in quotation marks where they occur in text; titles of books, newspapers, magazines and journals are italicized; as in,

  Marcille's paper "Industrial Zeolites in the Princeton Basin", *in* Geological Fieldwork 1988, is recommended reading for those interested in the agricultural applications of zeolites.

- Single quotation marks are used to enclose technical terms in nontechnical writing, colloquial terms in formal writing, slang, coined words and informal names. If the term is repeated later in the text, the quotation marks are not needed the second and subsequent times. **It is modern practice to use single quotation marks for this purpose.** Note: it is not necessary, and probably a bit silly, to enclose special terms in quotations within parentheses - use parentheses only unless the enclosed material is extensive and requires further clarification.

  Concentrator Hill is underlain by rocks of Robinson's 'imbricate zone'. A sample of amphibolite from the imbricate zone has been dated at 176 Ma.

- Modern practice places the comma or period at the end of a quotation inside the quotation marks. Other punctuation is placed outside, unless it is an integral part of the quotation.
- When a footnote reference is given to identify the source of a quotation, the superscript reference number is placed immediately following the closing quotation marks.
- Quotation marks are NOT used with indirect quotations or around proper names, company names or slogans.

SEMICOLON (;)

The semicolon can be considered a strong comma or a weak period. It is used:

- In place of a conjunction between two clauses in a compound sentence; for example,

  The affects of soft-sediment deformation are readily apparent in less competent rocks; the quartzites are massive and undisturbed.

- To separate parts of a sentence having equal weight, but which themselves contain commas.

  The vein is characterized by a quartz gangue; an abundance of sulphide minerals, including pyrite, galena and sphalerite; and a thin, graphitic selvage on the footwall.

However, if three or more short clauses are similar in form and closely connected in thought, use a comma to separate them.

It's black, it burns, it must be coal.

- Before *namely, for instance, for example, that is* and *as,* when introducing explanations. The introductory phrase is followed by a comma.

  The younger intrusions are pervasively pyritized and visible from the air as prominent stain zones; for example, the Knob Hill porphyry.

- A semicolon used in conjunction with closing quotation marks or parentheses, should be placed outside the other punctuation.

  Smyth describes the footwall of a orebody as "quartz-eye rhyolite with pervasive chlorite alteration"; these rocks were exposed in trenches that have since been filled in.

SOLIDUS (/)

The solidus is also known as a *slash, slant, diagonal* or *virgule*. Originally the solidus was used as a comma but in modern usage it:

- Separates divisors from dividends, *e.g.* 1/2.
- Implies the word *per, e.g.*, 5 kg/m^2.
- Indicates choice; as in, *yes/no* or *and/or.*
- Indicates ratios of specific value, *e.g.*, the Pb/Ag ratio is 86.72.
- Indicates isotopic ratios, *e.g.*, $^{87}Sr/^{86}Sr$.

Although the use of colon and solidus for defining ratios is well established in literature there are situations where consistency and visual impact dictate nonstandard usage. In such situations the Editor, in consultation with the author, will determine the most acceptable format.

ELLIPSES (...)

Ellipses are three dots used to indicate:

- The unfinished end of a quotation.
- The omission of a word or phrase from quoted material.

ASTERISK (*)

This mark, a six-pointed star in a superscript position, can be used:

- To signal a footnote.
- In place of bullets in an itemized list.

CROSSHATCH (#)

The crosshatch or double hashmark, can be used in tables or illustrations:

- To substitute for the word *number* if it precedes the number, *e.g.* #8.
- To substitute for the word *pounds* if it follows the number as in , 9#.
- It is a proofreader's sign for *space* and may be used to indicate *insert a space* or *delete space*.

DAGGER († ‡)

The dagger is used as a signal for a footnote or as an indication a word is obsolete. (*see* section on footnotes for details on usage).

AMPERSAND (&)

This is a symbol which may, in some situations, be used to replace the word *and*. It is derived from the Latin *et*, the two letters of which eventually became linked into a single squiggle by the scribes. It is not used within text but may be used in tables or illustrations to save space.

PARAGRAPH (¶)

This mark is most commonly used by editors to indicate a change in paragraphing of text.

REFERENCES

It is the responsibility of each author to ensure that each reference is complete and accurate. Errors in manuscripts are a common problem and there is nothing more irritating to a reader than to find their access to further information blocked by inaccurate or misquoted references. The quality of your research, your credibility as an author and the scientific integrity of the Geological Survey Branch will be not be perceived favourably.

Editing References for conformity of punctuation is tedious and time-consuming work: it would be very much appreciated if authors would follow these simple house-rules.

There is little uniformity in the geological literature when it comes to the punctuation of References. The Geological Survey Branch uses the following general format:

Diakow, L.J., Panteleyev, A. and Schroeter, T.G. (1985): Geology of the Toodoggone River Area (94E); *in* Geological Fieldwork 1983, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1984-1, pages 139-145.

- Publications are listed in alphabetical order by senior author, then by junior author(s), and then date of publication. If the same author(s) have multiple references from the same year they are distinguished by placing an *a, b, c, etc.*, after the date.

Ferri, F. and Melville, D.M. (1990a): Geology Between Nina Lake and Osilinka River, North Central British Columbia (93N/15, North Half and 94C/2, South Half); *in* Geological Fieldwork 1989, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1990-1, pages 101-114.

Ferri, F. and Melville, D.M. (1990b):Geochemistry and Mineral Occurrences Between Nina Lake and Osilinka River, (93N/15, 94C/2); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1990-17, Sheet 2.

- The author's family name appears first followed by initials for given names. Names are capitalized and quoted exactly as they appear in the original publication and should not reflect subsequent legal changes or variations to the name. There are no spaces between initials although they are punctuated by periods.
  When multiple authors are identified the conjunction *and* is used before the final author, a preceding comma is not used.
  If no author is given for a publication, the publisher or agency responsible for the work should be substituted. Unknown authors of manuscripts in compilation volumes, such as the Minister's Annual Reports, may be identified by the term 'Anonymous'.
- When a reference list contains multiple citations for the same author(s) the full names must be typed out for each reference. Do not use dashes.
- The publication date follows the author names and is enclosed in parenthesis and followed by a colon. It is not preceded by a comma after the last author.
- Titles are capitalized, except for prepositions and articles, and separated from publishing details by a semicolon. It is normal Branch usage that the NTS map sheet numbers be placed in parenthesis at the end of titles.
- Publishing details, *i.e.* publisher, series identification, volume, page numbers *etc.*, are separated by commas.
- Although normal branch usage would dictate that *rhyolite hosted* be hyphenated and *sulfide* spelt with a *ph*, the author's original style and usage must be retained in every detail, as with a quotation.
- The name of the publishing agency is italicized. Note: *B.C.* replaces *British Columbia* for all references citing the *B.C. Ministry of Energy, Mines and Petroleum Resources* as the publishing agency.
- The publication type or series identifier is presented in normal type and separated by commas.
- Abbreviations (Ed., *et al.*, Anon, CIMM, Vol., pp. *etc.*) are not used.
- Page numbers should be given if appropriate.
- References may be referenced as *in press* or *in preparation* but never as *submitted* or *in submission*.

Geological Fieldwork, Exploration in BC and other Compilation Volumes

- References to manuscripts included in compilation volumes which identify individual authors but have no specified editors are formatted thus:

Webster, I.C.L. and Ray, G.E. (1991): Skarns in the Iskut River – Scud River Region, Northwest British Columbia (104B); *in* Geological Fieldwork 1990, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1991-1, pages 245-253.

MacIntyre, D.G. (1992): SEDEX - Sedimentary Exhalative Deposits; *in* Ore Deposits, Tectonics and Metallogeny in the Canadian Cordillera, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1991-4, pages 25-70.

Greig, C.J. (1991): Reconnaissance Lithogeochemistry, Oweegee and Kinskuch Areas, Northwestern British Columbia (104A/11, 12; 103P/11); *in* Exploration in British Columbia 1990, *B.C. Ministry of Energy, Mines and Petroleum Resources*, pages 169 - 173.

Stasiuk, M.V. and Russell, J.K. (1990): Quaternary Volcanic Rocks of the Iskut River Region, Northwestern British British Columbia; *in* Current Research, Part E, *Geological Survey of Canada*, Paper 90-1E, pages 153-157.

- Compilation volumes which identify only an editor's name are formatted thus:

Reading, H.G. (Editor) (1978): Sedimentary Environments and Facies; *Elsevier*, New York, 557 pages.

- References to manuscripts in compilation volumes which include individual authors and an editor are formatted thus:

Roehler, H.W. (1986): McCourt Sandstone Tongue and Glades Coalbed of Rock Springs Formation; *in* Paleoenvironments and Tectonic Controls, Lyons, P.C. and Rice, C.L., Editors, *Geological Society of America*, Special Paper 210, pages 141-153.

- *Geological Fieldwork* **volumes issued in 1992 and subsequently, include editorial references and for these volumes the editor's name(s) must be included thus:**

Bobrowsky, P.T. and Smith, C.P. (1992): Quaternary Studies in the Peace River District, 1990: Stratigraphy, Mass Movements and Glaciation Limits; *in* Geological Fieldwork 1991, B. Grant and J.M. Newell, Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1992-1, pages 363-374.

Annual Reports Minister of Mines

The Annual Reports of the Minister of Mines for British Columbia have been issued continuously since 1874 and include such title variations as: Annual Report of the Minister of Mines; Minister of Mines Annual Report; Minister of Mines and Petroleum Resources Annual Report; and, Annual Report of the Ministry of Energy, Mines and Petroleum Resources. Regardless of year of issue, for the purposes of referencing they should be cited as *Minister of Mines Annual Reports* published by the *B.C. Ministry of Energy, Mines and Petroleum Resources*.

In addition the style and content of these reports has also changed over the years so that some variations in referencing are necessary.

- Individual reports which have an author identified should be formatted thus:

Kerr, F.A. (1929): Second Preliminary Report on Stikine River Area, British Columbia; *in* Minister of Mines Annual Report 1928, *B.C. Ministry of Energy, Mines and Petroleum Resources*, pages C126-C137.

- Frequently in these reports authorship is not identified or is very difficult to ascertain. In such cases material may be formatted thus:

Anonymous (1901): Nelson District - Ymir Gold Mines, Limited; *in* Minister of Mines Annual Report 1900, *B.C. Ministry of Energy, Mines and Petroleum Resources*, pages 838-842.

Thesis References

- References to thesis work produced as the end product of university-based research are normally formatted as follows:

Donnelly, D.A. (1976): A Study of the Volcanic Stratigraphy and Volcanogenic Mineralization on the KAY Claim Group, Northwest British Columbia; unpublished B.Sc. thesis, *The University of British Columbia*, 59 pages.

Note that the geographic location of the university is not included.

Unpublished Industry Reports References

- Many reports of a technical or general nature are produced by industry each year. Most of these are never published but may for various reasons appear as references for Geological Survey Branch research. Such unpublished reports are treated thus:

Blackwell, J.D. (1989): Eskay Creek Project Exploration Review 1932 to 1989; unpublished report, *Calpine Resources Incorporated* and *Consolidated Stikine Silver Limited*, 42 pages.

Assessment Reports References

Assessment Reports are treated the same as all geoscience reports. Individuals or companies should be identified as Author(s), NOT the Ministry. The ministry is given as the publishing agency and the Assessment Report number is given as the publication series/number; for example,

Horne, E.J. (1984): Prospecting Report on the Emma, Wallie and Phyllis Claims; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 11 077.

Gulf Resources Canada Ltd. (1981): Wapiti Project Geological Report; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Coal Assessment Report 00685.

MINFILE References

MINFILE data may be referenced either as individual records or as all or part of an official release. The senior author is always given as MINFILE plus the NTS designation for that map area; junior authors are the individuals who completed the major part of the research and coding or assisted in compiling the data. The publication date is the official release date for the dataset, or the date of coding/updating in the MINFILE system for datum or a dataset not part of an official release. The title is the name of the 1:250 000-scale map.

MINFILE 093D, Bailey, D.G. and Jakobsen, D.E. (1989): Bella Coola Occurrence Map; *B.C. Ministry of Energy, Mines and Petroleum Resources*, MINFILE, released Sept. 1989.

or for individual records or special datasets,

MINFILE 103P, Fischl, P. and Jakobsen, D.E. (1990): Grey Goose, MINFILE 103P 140; *B.C. Ministry of Energy, Mines and Petroleum Resources*. MINFILE data revised March 14, 1989.

RGS References

Regional Geochemical Survey (RGS) data should be referenced in the same way as MINFILE data. Please note that RGS releases may have one or more authors. Regardless the senior author should always be quoted as 'RGS' plus the 1:250 000-scale NTS identifier; for example,

RGS 082J, Matysek, P.F., Jackaman, W., Sibbick, S.J., Gravel, J. and Feulgen, S. (1991): Kananaskis Lakes area, NTS 082J; *B.C. Ministry of Energy, Mines and Petroleum Resources*, BC RGS 28 Regional Geochemical Survey release.

Note that many RGS surveys were joint federal-provincial projects and the results may have been published with dual series numbers (*e.g.* BC RGS 30/GSC OF 2355). If this is the case both numbers must be quoted in the reference.

in press – in preparation

These terms may be used in place of a publication date. They are intended to convey to a reader the idea that a new publication is imminent. However, they should not be used to cover up tardy research that has been ongoing for the past 15 or more years and that may never see the light of day.

In press means just that, the manuscript is at the printers. *In preparation* means the manuscript is being written, or has been edited and is in the final process of updating, typesetting or formatting before printing.

CITATIONS

Citations are used within the text of manuscripts to flag important information which is not the direct result of the author's research efforts and for which the author is required to allocate credit (or blame!). All references must be cited in the text and conversely all citations must have a complete and accurate reference in the References.

- The Geological Survey Branch uses the Author/date system for citations within the text when referring the reader to the References. Initials for given names are not included; for example,

  (Jones, 1990)

- If a work has two authors both names, separated by *and*, are cited; for example,

  (Smith and Jones, 1988).

- References with multiple authors are cited by the senior author's name only, and date.

  (MacDonald *et al.*, 1989)

- If the senior author's name appears within the text the date of the appropriate reference should appear in parenthesis; for example,

  The structural study by McClay (1987b) indicates ....

- Personal communications, *e.g.*, (A.R. Brown, personal communication, 1990), should be identified as such in the text but not included in the references. Abbreviations are not used. As there are no details in the references the full initials of the sources must precede the name.
- Extensive data obtained from another researcher but which has not been published may be cited in your manuscript as, (Katherine Jenkins, unpublished data, 1989).
- Multiple references by the same author(s) are presented in order of date separated by commas.

  (Smith, 1989, 1990a, 1990b, 1991)

- Where information is associated with multiple references the previous usage is followed and individual citations are presented in order of date and separated by semicolons.

  (Jones, 1989; Smith, 1990; Smith *et al.*, 1991)

- Citations may be used to identify specific information in a reference if necessary; for example,

  (Graham, 1962, p. 13)

- Extensive data obtained from another researcher but which has not been published may be cited. However, this type of citation is not to be used as a lazy way out of properly identifying researchers and their published material.

  (K.J. Drew, unpublished petrographic data, 1992)

- **Citations in the text of a report refering to computer data** (*e.g.* MINFILE or RGS) should identify the database, release or publication series if appropriate, and the release date for the data; for example,

  (MINFILE 093D, Sept. 1989)
  (RGS, BC RGS 30, 1991)

- **Computer data which is not part of an official release** should contain the name of the database, area of interest, and the month and year the data was retrieved from that particular database. The citation should be structured as follows:

  (MINFILE data, 082F, May 1992)
  (RGS data, 104M, January 1993)

Cross References

Internal cross-references using page numbers are not to be used. The correct page number cannot be inserted until the manuscript has been paginated and there is, therefore, a good chance that a reference will be missed or entered incorrectly in the final formatting. If internal referencing is necessary, cite chapter and subheading.

FOSSILS

Systematic descriptions of fossil data are normally not included in the main body of text for B.C. Geological Survey Branch reports. If systematic descriptions are necessary they should, in most cases, be included as appendices, as is the case for extensive geochemical or petrographic data. If such data are included they should conform to accepted international standards and include description, discussion, designation of a single name-bearing specimen, indication of other material used to establish the species description, stratigraphic and geographic distribution, and adequate illustration.

Varying degrees of accuracy and probability of identification may be expressed in a fossil citation. The following usage in the main body of text should be followed where possible.

Provided there is no ambiguity, abbreviations may be used when a species is mentioned more than once.

Genus & Species Names

Fossil remains are normally described by their formal generic and species names. **The genera and species names are italicized but all divisions higher than species are also capitalized. Do not capitalize adjectives or derived English nouns**. For example:

Orbiculoidea intermedia

but,

Brachiopoda or brachiopod

Protozoa **but** radiolarian

Genus or species names within quotes indicate the names are used in a very broad sense or probably in an incorrect sense.

Scientific Identification

The species name may be followed by the name of the scientist who named the species; if it appears in brackets, it means the species identified was originally assigned to another genus but that the current generic name is the correct one; if it appears without brackets it means the same author placed the species in the given genus.

Ellipsocephalus hoffi (Schlotheim, 1823)
Saccocoma pectinata Goldfuss

Use of 'Sp.'

Many fossils have only a generic name and their specific name is represented by the abbreviation **Sp.** (*species*) if the author cannot decide which species the specimen actually belongs to; **Sp.** is not italicized but in some cases may be put in boldface type; for example,

Archimedes **Sp.**

Use of '?'

The position of a question mark indicates different shades of doubt. A question mark after the generic name indicates an entire identification is doubtful:

Leptaena? concava Hall

A question mark after the species indicates the genus is correct but the species identification is questionable:

Leptaena concava? Hall

Question marks should stand against the doubtful term without space between, and they should not be enclosed in parenthesis.

Where question marks appear in the text associated with fossil names, normal punctuation ignores the presence of such marks.

Use of 'cf. ' and 'aff.'

The abbreviation **cf.** (*confer, i.e.* compare) after the generic name indicates there are doubts over the species identification:

Nummulites cf. *irregularis*

The abbreviation **aff.** after the generic name indicates the species is closely related to that identified but is possibly a different species (*aff.* implies less similarity than does *cf.*):

Leptaena aff. *L. rhomboidalis*

Plurals

A plural formed simply by adding 's' to the Latin name is not ordinarily italicized but may be capitalized. *e.g.* pectens or Pectens, mastodons or Mastodons. The anglicized form a Latin name, such as dinosaur, bryozoan and diatom is not capitalized. Coined words such as ammonoid or foraminifer are neither capitalized or italicized.

Fossil identification Credit

Opinions on age and correlation are the responsibility of the paleontologist who identified the fossils, and who must be acknowledged in the text. In most cases this means that specimens should be referred to by the locality and specimen catalogs of the Geological Survey of Canada; for example

(GSC locality 45677; GSC Type Specimen No. 76345)

Fossil identification by individuals or agencies other than the GSC should receive similar credit. **Authors should**

keep in mind that responsibility for all scientific data presented in a publication is theirs.

FOOTNOTES

Footnotes are not permitted in Branch publications such as *Geological Fieldwork* or *Exploration in British Columbia*. This is in large part due to the difficulties of tracking such anomalies during the editing and typesetting process. Footnotes, although discouraged, may be considered for other publications. However, in many cases the material can be more easily written into the text or included in parenthesis.

If footnotes are the only alternative to including important data, and they are few in number, the following are standard symbols used to flag the position in the text to which the similarly flagged footnote applies:

* † ‡ ** †† ‡‡

If footnotes are numerous they should be flagged in the text using sequential Arabic numerals and all footnotes should be placed in a section at the end of the text, after the References.

"The hyphen should be used only when necessary to clarify understanding. One must regard the hyphen as a blemish to be avoided wherever possible."

...Winston Churchill

COMPOUNDING WORDS

Words that are often used in close association tend to become unified in form as they are in meaning, and ultimately to acquire a single accent. There are three stages in the evolution of compound words. First the components are written separately; next they become hyphenated, finally they are combined into a single word; for example, *ore body*, *ore-body* and now *orebody*. The modern trend, especially with nouns, is to eliminate hyphens and write a compound word as soon as usage indicates that the linkage has become permanent. Other examples of this trend include: *drillhole*, *footwall*, *crosscut*, *headframe*, *byproduct* and *pipeline*.

The development of permanent compounds is simply a matter of usage; hyphenated compounds, which have not yet been accepted as unified words, are generally listed in dictionaries. Temporary compounds present more difficulty. They use a hyphen solely to clarify their relationship to other words in a particular context and they may change their form, depending on their position in a sentence. A rule of thumb is that compounds used adjectivally, to modify a noun that follows, are often hyphenated to avoid ambiguity; for example, is *an old book collector* a senior citizen who collects books? or someone of unspecified age who collects old books? In the absence of a hyphen the adjective modifies the word that follows it and you have described a collector of old books. If you intend the other interpretation, hyphenate book-collector to make your meaning clear. To remove any possibility of misinterpretation of the first alternative, you might write *old-book collector*, but this is perhaps going to the extreme and would qualify as one of Churchill's blemishes.

Hard and fast rules for hyphenation are difficult to formulate; Geological Survey Branch usage is outlined below.

COMPOUND NOUNS

Hyphenate:

- Two nouns of equal value.
  secretary-treasurer geologist-geochemist
- Nouns usually written as two words when the addition of a modifier may create ambiguity.
  a reinforced concrete powder-magazine
  a fibreglass core-box

but,

  a powder magazine
  a core box

Do not hyphenate:

- Compound nouns that have become accepted as unified words.
  However, if the compound noun has a modifier that applies only to the first part, the compound must be separated.
  carload **but,** Granby-car load

COMPOUND ADJECTIVES

The purpose of the hyphen in a compound adjective is to prevent misplacing the stress, or a momentary impression that the first word of the phrase modifies the third word rather than the second. Strict application of the rules will result in the use of a great many hyphens, sometimes more distracting than helpful. **Remember, justification for a hyphen is clarification**. Nevertheless, the following guidelines should be followed for consistency.

- Compound adjectives are generally hyphenated when they precede the noun they modify.
  potassium-argon dates deep-water sedimentation
  high-grade ore low-frequency signal
  short-term objective world-class deposit
  sedimentary-exhalative deposit

It can be argued that all the above examples are unlikely to be misunderstood; however, consider *a fine gold nugget*. This could mean a nugget of fine gold, or an unusually good specimen of nugget gold. There are, of course, other ways of getting around the ambiguity which deserve consideration, but the use of a hyphen solves the problem quickly and easily.

- Always use a hyphen when a **noun** is compounded with a colour or two colours are combined.
  olive-green mineral
  coal-black shale
  orange-yellow limonite stain
  grey-green siltstone

Adjectives modifying a colour (*e.g.* light, dark, pale, intense, greenish) are not connected to it with a hyphen. Note that colour modifiers ending in *ish* are covered by this rule.

- Hyphenate compound adjectives comprising a noun, adjective or adverb and a present or past participle; as in,
  northwest-striking fault
  frost-heaved boulder
  gold-bearing vein
  grey-weathering dolomite
  fining-upward sequence

However, if the compound is preceded by an adjective or adverb modifying the first word, omit the hyphen; for example,

metal-mining industry

but,

precious metal mining industry

well-managed program

but,

remarkably well managed program

- Hyphenate compound adjectives made up of an adjective and a noun to which *d* or *ed* has been added, when they precede the noun they modify; as in,

an acute-angled triangle
a limonite-stained outcrop

a fine-grained granite **but,** the granite is fine grained

As before, if the first word in the compound is modified, leave out the hyphen; hence:

a very fine grained granite

- Hyphenate compound adjectives when the adverb in the combination could be misread as the modifier of the noun.

More-open windows would improve staff morale by improving the view from the office.

as opposed to,

More open windows would improve ventilation in the office.

Do not hyphenate a compound adjective if:

- It follows the noun it modifies.
- It contains an adverb that could not possibly be misread as an adjective modifying the noun. The most common violation of this rule is the use of a hyphen with adverbs ending in *ly*.

equally effective methods too rugged terrain

- It is the name of an institution or a physical location.

science faculty professors city hall library

- Both elements are capitalized.

First Aid kit Safety First slogans

- The first element in the compound is a comparative or superlative.

better drained soil
larger sized grains
best preserved specimen
highest cost producer
lower ash seams

- If it is preceded by an adverb modifying the first word in the compound (*see* above).

PHRASES

A number of commonly used compound phrases are hyphenated, especially when used in an adjectival sense; for example,

west-side-down normal fault
basin-and-range topography
scour-and-fill structures
cut-and-fill stoping
search-and-report program

PREFIXES AND SUFFIXES

In modern usage, most words with prefixes or suffixes are written unbroken by a hyphen unless the addition forms a double vowel or consonant, as illustrated by the examples below:

calcalkaline	calcsilicate
bimodal	collinear
epiclastic	infrared
interlayered	microcrystalline
multiphase	nonreflective
postglacial	pretectonic
pseudoscience	semiarid
subrounded	supercooling
suprapose	transcontinental
tripartite	ultramafic

but,

semi-invalid	post-tectonic
meta-andesite	sub-bituminous

The prefixes *co, de, pre, post, pro* and *re* are usually not hyphenated; as in,

preglacial	prograde
decementation	recrystallization
coordinate	

but, the double vowel in the following words jar the eye so a hyphen is retained,

de-emphasize	re-entrant
pre-exist	

Please note however, that terms describing geological time used with the prefixes *pre* and *post* are both hyphenated and the age term is capitalized.

pre-Triassic post-Cretaceous

Suffixes are rarely hyphenated; however, temporary compound adjectives formed by adding the suffix *like* are sometimes useful to describe shape or form, and always take a hyphen; as in,

petal-like	nut-like
needle-like	rod-like

The suffix *like* should never be added to an adjective, as in *globularlike*; if the adjective does not seem quite right standing alone, you have chosen the wrong one. A few words ending in *like* have become permanent compounds incorporated in the language; they are only hyphenated if the root word ends in *L*; for example,

businesslike workmanlike warlike

but,

bell-like

SUSPENDED COMPOUNDS

A hyphen is not used following a suspended component common to two compound adjectives; hence,

pre and post-Triassic events
fine, medium and coarse-grained granite

not,

pre- and post-Triassic events
fine-, medium- and coarse-grained granite

NUMBERS, NUMERALS AND FRACTIONS

Geological Survey Branch usage for the hyphenation of written numbers and numerals is as follows:

- Hyphenate compound numbers from *twenty-one* to *ninety-nine*, when written out in full (usually only at the beginning of sentences).
- Hyphenate compound adjectives comprising a cardinal number and a noun or adjective; as in,
  two-mica granite six-sided polygon
- Hyphenate compound adjectives expressing a measurement; as in,
  1-metre sample 45-gallon drum

Multiple compound adjectives incorporating numbers, measures and dimensions are an ugly construction often used by Geological Survey Branch authors. There is invariably a more attractive alternative; for example,

a trench 30 metres long a bed 10 metres thick

not,

a 30-metre-long trench a 10-metre-thick bed

- Hyphenate ordinal numbers preceding the word they modify; as in,
  second-order anomaly first-class accommodation
- Hyphenate fractions used as modifiers, provided neither the numerator or denominator are already hyphenated; hence,

  a one-third share

but,

  ninety-nine hundredths

  It is preferred, however, that the second fraction be expressed as a percentage, *i.e.* 99 per cent.

COMPASS DIRECTIONS

Directions combining two compass points are run together, not hyphenated; in compounds of three compass points, insert a hyphen after the first; for example,

northwest **but,** north-northwest

Never use dual direction compass points to describe the strike or trend of a feature; for example,

an east-striking fault a north-trending lineation

not,

a north-s. uth trending lineation

SINGLE LETTERS AND FIGURES

Connect a single letter or number to the word it modifies if it is the first element of a compound. Do not use a hyphen when it is the second element; for example,

x-ray T-square
Class A park Type 2 alteration

CHEMICAL AND MINERALOGICAL TERMS

- Hyphenate combinations of elements used as adjectives; as in,
  lead-zinc-silver deposit
  copper-molybdenum porphyry
- Hyphenate metallic-element symbols used as adjectives; as in,
  Pb-Zn-Ag deposit Au-Cu porphyry
- Hyphenate chemical modifiers of mineralogic adjectives; as in,
  potassium-feldspar granite
- Hyphenate mineralogical modifiers if more than two are used in combination; hence,

  quartz-feldspar-biotite porphyry

but,

  quartz feldspar porphyry

- **Do not hyphenate** the names of chemical compounds used in an adjectival sense.
  carbon dioxide extinguisher
  copper sulphate crystals

WORDBREAKS

Breaking a word (syllabification) at the end of a line is often necessary in order to maintain the even spacing essential to the pleasing appearance of a printed page. The shorter the line, the more likely it is that the last word will be broken; the use of two-column format therefore tends to increase the number of wordbreaks depending on how the word processing programs treat syllabification. Although our publications software uses sophisticated programmed wordbreaks, a few simple rules govern Geological Survey Branch usage:

- A word may only be divided at the end of a syllable. Consult your dictionary for accepted usage in syllabification. **Words pronounced as one syllable, or which are less than 6 characters in length, should never be divided.**
- Two-syllable words in which one syllable is a vowel standing alone should not be divided.
- Two-letter syllables at the beginning or the end of a word should not be divided.
- The terminations *ical, sial, tial, cion, sion, gion, cious, ceous, tious,* and *geous* should not be divided.
- When the final consonant of a verb is doubled in forming the past tense or participle, the second consonant belongs with the letters following it; as in,
  ocur-ring map-ped run-ning
- When the meaning of a word changes on the basis of which syllable is stressed, the word must be divided according to its pronunciation; for example,
  proj-ect(noun) pro-ject(verb)
  prod-uce(noun) pro-duce(verb)
- Initials and abbreviations should never be broken; initials, titles and degrees should not be separated from the name they refer to.

- Hyphenation of given names, the names of provinces or the names of countries should be avoided.

ABBREVIATIONS

With few exceptions, Geological Survey Branch **strongly discourages the use of abbreviations in the body of written text, although they may be used within tables, footnotes, figure captions and parentheses.** On occasions when abbreviations are used to eliminate lengthy and tedious repetition, the term that is abbreviated should be written in full the first time it is used, with the abbreviation noted in parentheses. Branch practice is summarized as follows:

- **Shortened forms of the names of countries** are preferred to abbreviations; hence,

  the **United States** (of America),
  rather than the U.S.A. (not America)
  the **United Kingdom** (of Great Britain and Northern Ireland),
  rather than the U.K. (Great Britain is the preferred shortened form if only England, Scotland and Wales are included).

  If abbreviations are used, they must be fully punctuated except when they form part of a symbol or the abbreviation of a longer title; hence,

  U.S.A. **but,** US$ and USGS

- **Names of provinces, territories and districts** are not normally abbreviated.

The abbreviation *B.C.* for British Columbia is convenient, but manifests little pride in our province. You would probably be slightly taken aback to run across a USGS Professional Paper entitled *Gold Deposits in the Black Hills of S.D.* Californians do not refer to their state as *Calif. or CA*, nor Albertans to *Alta.*, except in their mailing addresses, and the British generally abhor the colloquial expression *U.K.* As British Columbians we should treat the name of our province with similar deference.

However, the abbreviation *B.C.* is used in References (*e.g.*, B.C. Ministry of Energy, Mines and Petroleum Resources) and in parenthetical or tabular material where brevity is important.

- **Physical features used in place names** (Mount, Point *etc.*) are not abbreviated. However, custom and usage dictate the abbreviation of *Saint* and *Sainte* when used in place names; as in,
  Fort St. James Sault Ste. Marie
- **Titles preceding personal names, and titles, honours or degrees** following a name are always abbreviated and fully punctuated; as in,
  Mr. John Jones Hon. William Robinson
  David B. Smith, Jr. A.B. Brown, Ph.D.
  Lt. Andrew Anderson, D.F.C.

  The title *Honourable* is not abbreviated if preceded by the word *the;* it is not used with a surname alone.

  Formal styling should not be used with informal names; hence,
  Dr. Robert A. Floyd **not,** Dr. Bob Floyd

- **Days of the week and months of the year** are always written in full in the body of the text or footnotes, but may be abbreviated in tables.
- **Compass directions** are not abbreviated in the body of the text or footnotes; standard abbreviations (NNW, ESE *etc.*) are used in tables and are not punctuated.
- **Ordinal forms of the numerals** one to nine (1st, 2nd, 3rd) are not used in the text. Ordinals of larger numbers (21st, 76th) are used but are not followed by a period as they are not true abbreviations.
- **Latin words and phrases:** a number of abbreviations of Latin words and phrases are used frequently in scientific literature, including:

  i.e. (id est) - that is
  e.g. (exempli gratia) - for example
  etc. (et cetera) - and so forth
  ca. (circa) - about, denoting approximate time
  q.v. (quo vide) - which see
  viz. (videlicet) - namely
  cf. (conferre) -confer, compare
  et al. (et alii) - and others
  ibid. (ibidem) - the same
  et seq (et sequens) - and the following
  vs. (versus) - against
  loc. cit. (loco citato) - in the place cited.
  ms. (manuscriptum) - manuscript
  N.B. (nota bene) - mark well
  op. cit. (opere citato) - in the work cited.
  sic (sik) - so, thus

  Although some of these expressions are useful, in many cases there is no reason, other than affectation, for preferring the Latin phrase over its English translation. With the exception of *et al.*, used for citing references with more than two authors, the use of these abbreviations is discouraged in Geological Survey Branch publications. However, they are permitted within parentheses, figure captions and tables. **They are always italicized and fully punctuated when used.** Note that most of these terms are usually followed by a comma.

- In all cases other than in the abbreviations of degrees, titles, countries and other political jurisdictions and Latin phrases, Geological Survey Branch usage omits periods punctuating acronyms; hence,
  FAME MDA NATO

GSC	RCMP	USGS
NTS	GSB	RGS

SYMBOLS

- Symbols, including formal symbols for SI units and chemical symbols of the elements, are not normally used in the body of the text; hence,

per cent,	**NOT** %
grams per tonne,	**NOT** g/t
copper,	**NOT** Cu

However, symbols for SI units, preceded by a number, are used in tables and figures. There should always be a space between the number and the symbol, and no period following it.

Exceptions to this usage are:

- The use of chemical symbols in complex chemical formulae or in chemical equations; for example,

atacamite [$CuCl_2 \cdot 3Cu(OH)_2$]

$CaCO_2+H_2SO_4 = CaSO_4+H_2O+CO_2$

Nevertheless, chemical symbols should not be substituted for the names of common chemical compounds in normal sentence construction.

water	**NOT** H_2O
oxygen	**NOT** O_2
carbon dioxide	**NOT** CO_2

- Symbols for chemical elements should always be used for ratios of elements; such as,

The Au/Ag ratio is 0.315.

- The use of symbols is permitted for some non-SI units in general use, and which occur repeatedly in geological writing; namely,

parts per million, billion: ppm, ppb
million years: Ma
billion years: Ga
degrees Fahrenheit, Celsius: °F, °C
degrees, minutes and seconds of arc: ° ′ ″
currency: $, £

- Symbols are used for units of currency when they are followed by a number; hence,

Most metal prices are quoted in American dollars.

but,

The current price of copper is US$1.20 per pound.

Prices on the London Metal Exchange are quoted in pounds sterling.

but,

The LME price of lead is now £430 per tonne.

- Dollar values are stated in Canadian funds unless otherwise indicated. Where, for clarity, it is necessary to specify Canadian currency C is the accepted symbol; for example,

The price of copper is US$1.20, or C$1.52.

CHEMICAL SYMBOLS

The use of symbols to represent chemical elements in technical manuscripts is common. It is the policy of the branch to utilize such symbols provided that such use clarifies the material presented and is not used to excess. Normally chemical elements are to be written in full and **the first use of an element name must always be written in full**, regardless of the usage in the balance of the manuscript.

- Chemical element (not compounds) symbols may be used, at the Editors discretion, in the main body of the text, provided:
  - Element symbols are always capitalized.
  - They are NOT used to begin a sentence.
  - The first use of the element in a manuscript is always written in full.
  - That the use of names or symbols is consistent within sentences; NOT,

The sample contained Au, copper and silver.

but,

The sample contained gold, copper and silver.

or,

The sample contained Au, Cu and Ag in silicates.

  - Use of element symbols eliminates long strings of common chemical terms.

Samples were analyzed for Au, Ag, Cu, Pb and Zn.

but,

The sample was analyzed for gold.

- The names of rocks or minerals must always be written in full, or if there is a mixture of elements and compounds the full text must be used; hence,

The deposit contains galena, sphalerite and iron sulphides.

- Symbols are used to express ratios of elements within the main body of text; for example,

$^{206}Pb/^{208}Pb$ Cu:Au K-Ar

The solidus should be used to indicate ratios when specific values are presented. The colon should be used when ratios are discussed in more general terms. The en dash should be used to indentify element associations used in age dating; for example,

The Pb:Zn ratios were ideal.
The Au/Ag ratio is 0.327.
The K-Ar dating method is common.

TABLE OF MISCELLANEOUS SYMBOLS

Greek Alphabet

Alpha	α
Beta	β
Gamma	γ
Delta	δ
Epsilon	ε
Zeta	ζ
Eta	ιι
Theta	θ
Iota	ι
Kappa	κ
Lambda	λ
Mu	μ
Nu	ν
Xi	ξ
Omicron	ο
Pi	π
Rho	ρ
Sigma	σ
Tau	τ
Upsilon	υ
Phi	φ
Chi	χ
Psi	ψ
Omega	ω

Scientific Symbols

Plus	+
Minus	−
Plus or minus	±
Multiplied by	×
Divided by	÷
Equal to	=
Not equal to	≠
Identical with, congruent	≡
Not identical with	≡
Similar to	~
Nearly equal to	≈
Greater than	>
Less than	<
Greater than or equal to	≥
Less than or equal to	≤
Perpendicular to	⊥
Diameter	∅
Sum	Σ
Therefore	∴
Infinity	∞
Square root	√
Angle	∠
Integral	∫
Pi	π
Degree	°
Minute, foot	′
Second, inch	″
Resistivity	ρ
Conductivity	γ
Salinity	‰
Varies as	α

Miscellaneous symbols

Trademark	™
Registered	®
Copyright	©
At, apiece	@
Per cent	%
Dollars	$
Pounds sterling	£
en dash	–
em dash	—
Footnotes	*†‡

COMPANY AND PROPERTY NAMES

COMPANY NAMES

A company's registered name is its legal identification and must always be written in full the first time it is used in a manuscript. Believe it or not, it was once necessary to write *The Consolidated Mining and Smelting Company of Canada, Limited* on every tag and affidavit for every claim staked on behalf of Cominco, and that was in the days of 50-acre claims. A company's correct name is often not well known, the principal problem being whether such words as *Company, Limited, Incorporated* and *Corporation* are written in full or abbreviated. If you know the correct name, use it. If not, the current edition of the **Canadian Mines Handbook** is to be used as a reference, although it is by no means totally reliable, frequently using abbreviations where there are none in the legal name. As a rule of thumb, *Incorporated* is most often shortened to *Inc.* and *Corporation* is rarely abbreviated, although the handbook almost invariably uses the shortened form. Generally accepted short forms of company names may be used for subsequent references, to avoid excessive repetition; for example,

> Asarco for Asarco Exploration Company of Canada Limited
>
> Brunswick Mining and Smelting for Brunswick Mining and Smelting Corporation Limited

Companies sometimes change their names; in historical accounts of exploration and development work, **it is customary to use the name the company operated under at the time the work was done**. When a company has recently changed its name, or merged with another, the new name may not be familiar to the reader and the former name should be noted in parentheses; hence,

> Campbell Red Lake Mines Limited (more recently Placer Dome Inc.)
> Minnova Inc. (formerly Corporation Falconbridge Copper)

Note also that a company is a singular entity and therefore takes a singular verb.

PROPERTY AND CLAIM NAMES

The name by which a property is generally known is usually listed in MINFILE and is often the name of the first claim staked. If a name other than that recorded in MINFILE is now commonly used, the MINFILE name should be noted in parentheses.

Claim names are determined by the staker and may not follow the rules of spelling or punctuation; they must be written as recorded in the Mineral Titles office. If the staker was an admirer of Tolstoy, but a poor speller, and recorded the *Warr and Pierce* claim, the *Warr and Pierce* claim it remains until it lapses.

Authors are responsible for ensuring that the property and claim names they use in manuscripts are correct.

NUMBERS AND MEASURES

As a general rule, the numbers twelve and under, and rounded numbers (*e.g.* about two hundred years ago), are expressed in words when they occur in the body of the text. **Figures are always used when a number** (even a single digit number) **precedes a unit of measurement**.

two rivers

but,

2 tonnes

LARGE NUMBERS

- **Double-digit numbers** larger than twelve (unless rounded) are always written as numerals.
- If specific numbers and round numbers appear in the same paragraph, the specific number governs the style.

  There were 1240 employees on the mine in 1989 with about 700 working underground.
- If necessary to avoid confusion use figures even for round numbers; as in,

  Attendance at the conference was 600 or 700

  is clearer than,

  Attendance at the conference was six or seven hundred.
- **Numbers with seven or more digits** that are rounded to the nearest 100 000 are best written as a hybrid of words and figures.

  Annual production exceeds 3.7 million tonnes of ore

  is preferable to,

  Annual production exceeds 3 700 000 tonnes of ore.
- **Numbers that are the first word in a sentence** are always written in words. Avoid sentences that begin with large numbers, by changing the construction.

SMALL NUMBERS

- Small numbers are set in numerals when they occur in a group with larger numbers and refer to similar things; hence,

  Of the total of 101 drill holes, 63 intersected the mineralized zone, 32 were barren and 6 were abandoned before reaching target depth.
- Numbers used in combination with abbreviations or symbols are always set in numerals.

  No. 3 **NOT**, No. three
- When two separate numbers are adjacent to each other in a sentence, use an alternative style for each, or restructure the sentence.

  six 100-gram samples 100 six-gram samples

FRACTIONS

Where possible express fractions as decimals; it is tidier and more professional.

- **Fractions expressed in words** are governed by the rules applied to whole numbers.
- **Fractions expressed in figures** should NOT be followed by *a(n)* or *of a(n)*. If the sentence seems to require this construction, the fraction must be written out.

  ½ inch **NOT**, ½ an inch

  half a bottle **NOT**, ½ a bottle

  but preferably,

  0.5 inch, 31.25 kilometres or 0.25 per cent

DECIMALS

- Always use decimals with units of the SI or metric systems.
- Decimal numbers should be presented as whole numbers whenever possible. *e.g.*, 0.0673 metres is preferred as 67.3 millimetres.
- Always place a zero before the decimal point for quantities less than one, except where usage demands otherwise (*e.g.*, .303 calibre rifle).
- Remember that fractions are less than one and are therefore followed by a singular noun.

  0.67 *gram* per tonne but, 122.3 *grams* per tonne

PERCENTAGE

The words *per cent* should always be preceded by numerals, decimalized if necessary, but never expressed as fractions. Use the percentage symbol (%) in tabular material or within parenthesis, but not in the body of the text.

DIMENSIONS

Dimensions are always expressed in numerals as they include units of measurement. Use *by* rather than the times sign in the body of the text.

10 by 25 metres **NOT**, 10x25 metres

DATES

If two year-numbers **in the same century** are connected by a hyphen, the hundreds are omitted from the second, unless the first ends with two zeros, in which case the second

number must be written in full.

1900-1980 **NOT** 1900-80;
1985-2005 **NOT** 1985-05;

but,

1901-09

In those cases where you refer to events occurring during a specific time period an *s* is added to the decade without an apostrophe; for example,

During the 1890s the mining industry ...

GEOLOGICAL TIME

Geological time is preferably quoted in millions of years (Ma). Billions of years (Ga) or thousands of years (Ka) should be avoided if possible.

MINFILE NUMBERS

Every recorded mineral occurrence in British Columbia has been assigned a unique number in the provincial mineral inventory system (MINFILE©).

The first three digits and a letter indicate the 1:250 000-scale map sheet covering the location of the occurrence; the last three digits are unique to the occurrence. Some map areas [National Topographic System (NTS) maps 082E, 082J, 082L, 092G and 092H] are divided into NE, NW, SE and SW quadrants for MINFILE; these designations follow the NTS identification; as in,

082ENW041

Where quadrants are not specified the MINFILE number should contain a single space; as in,

103F 112

All mineral occurrences mentioned in Geological Survey Branch publications should be referenced by MINFILE number. However, a large number of such references will tend to clutter so you should try to eliminate multiple text references by including MINFILE numbers in a table format.

If you are describing more than one numbered MINFILE occurrence, quote the digits that identify each of them, separated by a comma and omitting leading zeros except for the first occurrence; for example,

082ENW041, 43, 112
103F 036, 44, 49

Authors should remember that MINFILE, as a copyrighted term, is always written in full capital letters.

MEASUREMENTS AND CONVERSIONS

THE INTERNATIONAL SYSTEM OF UNITS (SI)

The use of SI units is required in all publications of the Geological Survey Branch

The modern metric system, known as the International System of Units (Systeme International d'Unites) or SI, has been adopted by 145 countries. The Parliament of Canada unanimously endorsed its adoption in 1970 and it has since been introduced gradually in different areas of Canadian industry. SI is a new system of measurement, not one of the old metric systems used in Europe or traditionally in the pure sciences: **SI is metric, but metric is not necessarily SI.**

There are three classes of SI units: base units, supplementary units and derived units. Each unit is designated by a specific symbol, identical in every language. As in the case of chemical symbols, they are not abbreviations, they do not take an *s* to form the plural and are not followed by a period.

SI USAGE IN THE GEOLOGICAL SURVEY BRANCH

Geological Survey Branch usage generally excludes symbols in the body of a written text; exceptions include degrees Celsius (°C), megayears (Ma), parts per million (ppm), parts per billion (ppb) and degrees, minutes and seconds of arc used to express latitude, longitude, azimuth and inclination. These units are used repetitively and are distracting if written out in full. Use of symbols is permissible in tables, footnotes *etc.* Other rules of usage are:

- The letter *t* is sometimes used incorrectly, as an abbreviation for *ton*; to avoid possible confusion, the SI unit *tonne* (or metric ton) is always written out in full.
- SI symbols are always written in upright type, irrespective of the typeface used in the accompanying text.
- A space is left between the numerical quantity and the symbol.
- Commas are not used to separate portions of SI units.
- Names and symbols must not be used together to describe derived units (*N•m* not *newton m*).
- The measure preceding a symbol is always written numerically, except at the beginning of a sentence (25 km not twenty-five km).
- In those cases where abbreviations for metric measurements are used they are never pluralized. Hence, 102 Km or 32 m.

BASE UNITS

The system is founded on seven base units as follows:

Quantity	Name	Symbol
Length	metre	m
Mass	gram	g
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K (not °K)
Luminous intensity	candela	cd
Amount of substance	mole	mol

The quantities *length* and *mass* are the most commonly used in geological writing.

SUPPLEMENTARY UNITS

There are two purely geometric units in this class.

Quantity	Name	Symbol
Plane angle	radian	rad
Solid angle	steradian	sdr

DERIVED UNITS

Most derived units do not have specific names; they are expressed algebraically in terms of other units. A short list of units in common use is provided as follows:

Quantity	Description	Expression in terms of Other Units
Area	square metre	m^2
Volume	cubic metre	m^3
Linear speed	metre/second	m/s
angular speed	radian per second	rad/s
Density	kg/cubic metre	kg/m^3
Concentration	mole/cubic metre	mol/m^3
Torque	newton metre	N•m
Surface tension	newton/metre	N/m
Heat flux density	watt/square metre	W/m^2
Thermal conductivity	watt/metre kelvin	W/(m•K)
Electric field strength	volt per metre	V/m
Current density	ampere/square metre	A/m^2
Magnetic field strength	ampere/metre	A/m

OTHER UNITS IN USE WITH SI

Some non-SI units have been designated as acceptable to use with the system since they are in very general use These are:

Name	Symbol	Value in SI Units
hectare	ha	10 000 m^2
minute	min	60 s
hour	h	3600 s
day	d	86 400 s
year	a	
degree (of arc)	°	(π/180) rad
minute (of arc)	′	(π/10 800) rad
second (of arc)	″	(π/648 000) rad
litre	L	10^{-3} m^3
tonne (metric ton)	t	10^3 kg
degree Celsius	°C	for temperature interval = 1K

The International Committee of Weights and Measures recommends that certain old metric units not be used and the intention in Canada is to comply. These discontinued units include: *calorie, erg, dyne, gauss, oersted, angstrom, micron, gamma, mho* and *curie*

SI PREFIXES

Prefixes are added to both base and derived units to form the names and symbols of SI unit multiples. There is no space between prefix and unit symbols when typeset. Prefixes, multiplication factors and symbols are given in the following table:

Multiplication Prefix	Prefix Factor	International Representation	System
giga	10^9	1 000 000 000	G
mega	10^6	1 000 000	M
kilo	10^3	1 000	k
hecto	10^2	100	h
deca	10^1	10	da
deci	10^{-1}	0.1	d
centi	10^{-2}	0.01	c
milli	10^{-3}	0.001	m
micro	10^{-6}	0.000 001	μ
nano	10^{-9}	0.000 000 001	n

New units are formed by combining prefix symbols with unit symbols. These new symbols can have exponents; for example, $1cm^3$. Compound prefixes, however, should not be used.

1000 tonnes NOT. kkg kilokilogram

UNITS FORMED BY MULTIPLICATION AND DIVISION

- The product of two or more units is indicated by a dot. The dot is raised above the line, as in *N•m* (newton metre).
- Multiplication is indicated by a space if the full names of units are used, as in *newton metre*.
- A compound unit formed by division is expressed using a solidus (/). Only a single solidus may be used in an expression, *e.g.*, m/s^2 not, m/s/s.
- Division is indicated by the word *per* when the names of units are used, as in *metres per second*.

METRIC CONVERSION

GSB publications should always be written with SI units unless Imperial measures are necessary for the clarity of the text or when a publication is intended for a specific client group who may be unfamiliar with the SI measurement system. In cases where both SI and Imperial measures are cited, the Imperial measure should appear in parentheses, however, where Imperial measures are used in quoted passages, they are quoted verbatim with the SI equivalent in square brackets.

In cases where a quantity was clearly measured originally in Imperial units, it is preferable to use this procedure, for example, *a pressure of 2 atmospheres* is more meaningful to most readers than *a pressure of 202.6 kilopascals* and it should therefore be expressed as *"a pressure of 2 atmospheres (202.6 kPa)"*

Where a converted Imperial measure has obviously been rounded off, the metric conversion must also be rounded. The above example would be correctly written as *a pressure of 2 atmospheres (~200 kPa)*.

Failure to exercise common sense when rounding metric conversions is a common failing which, at best, implies a degree of precision which does not exist, and at worst, invites ridicule. Many topographic maps used by geologists to determine elevation are contoured in feet, however the statement: *The porphyry is exposed on the western slope of Big Rock Candy Mountain at an elevation of 1371.6 metres (4500 feet)*. suggests that the author has not considered that neither his map reading nor his altimeter are accurate to the nearest ten centimetres. The metric expression should be rounded at least to 1370 metres while 1350 or 1400 metres probably better reflects the actual precision of the observation.

TABLE OF CONVERSIONS
For Commonly Used Units

1 acre		= 0.405 hectare
1 acre		= 4046.856 square metres
1 atmosphere		= 101.325 kilopascals
1 bar		= 100 000 pascals
1 millibar		= 0.1 kilopascal
10 bars		= 1 megapascal
1 BTU		=1055.06 joules
1 carat		=100 grams
1 chain		=20.117 metres
1 cord		=3.625 cubic metres
1 cubic foot		= 0.028 cubic metres
1 cubic foot		= 28.317 litres
1 cubic foot/minute		= 0.472 litres per second
1 cubic inch		= 16.387 cubic centimetres
1 cubic inch		= 0.016 litres
1 cubic yard		= 0.765 cubic metre
1 foot		= 0.3048 metre
1 foot/minute		= 5.08 millimetres per second
1 gram per tonne	= 0.0292 ounce per short ton	
1 Imperial gallon	= 4.546 litres	
1 Imperial gallon	= 0.0045 cubic metre	
1 US gallon		= 3.785 litres
1 US gallon		= 0.0038 cubic metre
1 gallon/minute		= 0.063 litres per second
1 hectare		= 2.471 acres
1 horsepower (electric)		= 746 watts
1 inch		= 2.54 centimetres
1 inch of mercury	= 3.386 kilopascals	
1 knot		= 1.852 kilometres/hour
1 mile		= 1.609 kilometres
10^3 gallons/day		= 4546 cubic metres per day
1 radian		= $180°/p$
p radians		= 180°
1 troy ounce		= 31.1034768 grams
1 ounce		= 28.350 grams
1 fluid ounce		= 28.413 millilitres
1 troy ounce/short ton		= 34.286 grams per tonne
1 pound		= 0.454 kilogram
1 pound/square inch		= 6.895 kilopascals
1 ppm	=1 gram	= 0.0001 per cent
1000 ppm	=1000 grams	= 0.1 per cent
10 000 ppm	= 10 000 grams	= 1.0 per cent
1 quart		= 1.137 litres
1 square inch		= 6.452 square centimetres
1 square foot		= 0.093 square metres
1 square kilometre		= 100 hectares
1 square yard		= 0.836 square metres
1 long ton (2240 lb)		= 1016.04 kilograms
1 short ton (2000 lb)		= 907.18 kilograms
1 yard		= 0.914 metre

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APPENDIX I
Bibliographic References

PARTIAL LIST OF PERIODICALS and PUBLISHING AGENCIES

Please consult the following list for the official titles and spelling of journals or publishers used in references or bibliographies.

Academic Press
Alberta Report
American Association of Petroleum Geology, Bulletin
American Mineralogist
Analyst
Analytica Chemica Acta
Analytical Abstracts
Analytical Chemistry
Applied Spectroscopy
Arizona State University
Association of Exploration Geochemists
Atomic Spectroscopy
Brick and Clay
Brock University
Bulletin du Bureau du Recherches Geologique et Minieres
Bulletin du Centre de Recherches de Pau
California Institute of Technology
Canadian Geographic
Canadian Institute of Mining, Metallurgy and Petroleum Bulletin
Canadian Journal of Earth Sciences
Canadian Journal of Economics
The Canadian Mineralogist
Canadian Mining Journal
Canadian Petroleum Geology, Bulletin
Carleton University
Chronique de la Recherche Miniere
Coal Age
Coal International
Dalhousie University
Earth and Planetary Science Letters
Earth Science Reviews
Economic Geology
Economist Publishing Co.
Engineering and Mining Journal
Exploration and Mining Geology (Journal of Geological Society of Canadian Institute of Mining, Metallurgy and Petroleum)
Geochimica et Cosmochimica Acta
Geological Society of America, Bulletin
Geological Society of London, Journal
George Cross Newsletter
Geoscience Canada
The Institution of Mining and Metallurgy, Transactions
Institute of Earth and Planetary Physics
John Wiley & Sons, Inc.
Journal of Chemistry and Physics
Journal of Geology
Journal of Petrology
McGill University
McMaster University
Memorial University of Newfoundland
Mineralium Deposita
Oregon State University
Pergamon Press
Prospectors and Developers Association
Queen's University
Royal Society of Canada
Saint Francis Xavier University
Science
Society of Petroleum Engineers, Journal
Spectrochimica Acta
Saint Mary's University
Tectonophysics
University of Alberta
The Gangue
The University of British Columbia
University of Montreal
University of Saskatoon
University of Toronto
University of Western Ontario
University of Washington
University of Waterloo
University of Windsor
University of Victoria
Western Washington University
Washington Department of Natural Resources
Yale University

PROVINCIAL/STATE GOVERNMENT MINISTRIES AND DEPARTMENTS

Department of Energy and Natural Resources, Alberta
Mineral Resources Division, Alberta
Energy Resources Conservation Board, Alberta
B.C. Ministry of Energy, Mines and Petroleum Resources
Department of Natural Resources, Manitoba
Department of Natural Resources, New Brunswick
Department of Natural Resources, Newfoundland
Department of Renewable Resources, Northwest Territories
Department of Mines and Energy, Nova Scotia
Ministry of Energy, Ontario
Ministry of Natural Resources, Ontario
Department of Energy and Forestry, Prince Edward Island
Ministere de l'Energie et des Ressources, Quebec
Department of Energy and Mines, Saskatchewan

Department of Renewable Resources, Yukon

FEDERAL GOVERNMENT ORGANIZATIONS

Energy, Mines and Resources, Canada
Geological Survey of Canada
United States Geological Survey
United States Bureau of Mines

APPENDIX II
Publication-Series Notes

INTERPRETATION OF GALENA LEAD ISOTOPES FROM THE STEWART-ISKUT AREA*
(103O, P; 104A, B, G)

By Colin I. Godwin, Anne D.R. Pickering and Janet E. Gabites
The University of British Columbia
and
Dani J. Alldrick

KEYWORDS: Galena lead isotope, lead fingerprint, deposit age, deposit origin, Jurassic, Hazelton Group, Tertiary, plutons, Stewart, Iskut, Stikine Terrane.

INTRODUCTION

The Stewart-Iskut area has had the most exploration activity in the Canadian Cordillera for the last decade. Consequently, this paper examines all available galena lead isotope data related to this area. These data are from LEAD-TABLE, a dBaseIV file of about 2000 deposits in British Columbia, Yukon Territory and adjacent Northwest Territories (Godwin *et al.*, 1988).

Table 2-9-1 has 197 galena lead isotope analyses from 60 mineral occurrences. This represents less than 10 per cent of the almost 800 showings in the study area, as listed in MINFILE, the mineral inventory database of the British Columbia Ministry of Energy, Mines and Petroleum Resources. The importance of the Stewart-Iskut area is emphasized by the observation that it contains about eight per cent of the total mineral occurrence inventory of the province.

This paper shows how galena lead isotope fingerprints can be used to date deposits in the Stewart-Iskut area (Figure 2-9-1). The isotope data in Table 2-9-1 define two clusters of points (Figures 2-9-2 and 2-9-3). One represents Jurassic gold-silver-copper-zinc-lead mineralization that is cogenetic with the Hazelton Group and associated plutons. The second cluster identifies Tertiary silver-zinc-lead ± molybdenum showings that are related to plutons. Historically, the Jurassic deposits have been of more economic significance than the Tertiary showings. So, galena lead isotopes provide a simple, effective method for evaluating the economic potential of newly discovered or poorly exposed showings.

GENERAL GEOLOGY

Most of the Stewart-Iskut area is within the Stikine Terrane of the Intermontane Belt. The western edge of the area probably includes portions of the Wrangell Terrane of the Insular Belt. All rocks of the region have been intruded by Eocene plutons and dikes of the Coast plutonic complex. The following description of the general geology is confined to Stikinia because it contains most of the occurrences examined here.

Stikine Terrane in the study area consists mainly of Mesozoic Hazelton Group that rests on rarely exposed Paleozoic "basement". Triassic to Early Jurassic strata of the Hazelton Group represent an evolving volcanic arc. This arc consists of a lower mafic volcanic complex that evolved to a thick andesite package which grades upward into dacites of the Mount Dilworth Formation. The Early Jurassic Texas Creek plutonic suite, characterized by potassium-feldspar megacrystic granodiorite, is cogenetic with Hazelton Group volcanics. In the Middle Jurassic the volcanic arc foundered and was covered by a thick succession of turbidites. In the mid-Cretaceous the entire area was regionally metamorphosed to lower greenschist facies.

LEAD FINGERPRINTS

The lead fingerprints (Figures 2-9-2, and 3) divide all but 10 per cent of the showings examined into two groups. Table 2-9-2 shows that 37 of the showings are Jurassic, 24 are Tertiary, and 5 are not clearly defined. Table 2-9-4 summarizes the galena lead isotope ratios for the two clusters.

DISCUSSION

The regional mid-Cretaceous metamorphism makes dating of Triassic to Jurassic mineralization by simple radiogenic isotopes (potassium-argon or rubidium-strontium) impossible. Galena lead isotopes, however, are not reset by thermal events alone. This emphasizes one of the advantages of the analyses presented here. In addition, at $300 an analysis, the method is relatively inexpensive.

Jurassic and Tertiary clusters of galena lead isotope ratios in the Stewart area were first recognized by Godwin *et al.* (1980). In 1986 Alldrick submitted a suite of samples from ten deposits on eight properties from the same area. The results of this work, reported in Alldrick *et al.* (1987), were so definitive that additional samples were collected from as many showings in the Stewart-Iskut area as possible. A preliminary interpretation of resulting data was presented by Alldrick *et al.* (1990).

The clusters clearly define two separate, relatively short-lived metallogenic events. An Early Jurassic and a Tertiary interpretation for these events is consistent with stratigraphic information and other radiogenic dates. Brief

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

GEOLOGICAL FIELDWORK
A Summary of Field Activities and Current Research

Geological Fieldwork is published annually in January; it is the chosen vehicle for scientists of the Geological Survey Branch to publish annual summaries of their research in progress. It is expected that most officers of the branch will contribute (for mineral occurrence and economic geology research also *see Exploration in B.C.).*

PUBLICATION FORMAT

Geological Fieldwork is published in 8.5 by 11-inch, two-column format. The manuscript is phototypeset, illustrations are restricted to page size or smaller, and the use of colour is not permitted. Line drawings are not professionally drafted, and are the responsibility of authors; graphics of poor quality will be rejected: **if vital to the objectives of the manuscript this may also result in rejection of the manuscript**.

Papers will vary in length, depending on the subject, but should not exceed 10 000 words; most papers will be much shorter, in the range of 1000 to 5000 words. On a practical level this ranges between about 3 and 20 pages, including all illustrations.

DEADLINES

The publication schedule is normally very tight and requires the cooperation of authors, input typists, the Editor and the Queen's Printer. **The full cooperation of all concerned is essential if the production deadline is to be met.**

To smooth the publication process and allow for recycling edited manuscripts for revision and approval, the flow of manuscripts is divided into several streams, each with a different set of deadlines. Deadlines for submission of manuscripts to the Editor will extend over the period mid-October to mid-November. The Editor will contact potential authors to commit to specific deadlines. **All authors external to the Geological Survey must commit to a mid-October deadline**.

Manuscripts submitted for editing after the assigned deadline, will go to the back of the queue. They will be edited on a time-available basis after all papers received on time are dealt with. This may result in late manuscripts not being published.

PUBLICATION PROCEDURES

Publication is initiated by completion of a tracking form (Publication Initiation Form, or PIF) obtainable from the Editor. This must be done prior to submission of manuscripts to managers for approval. In the case of out-of-town authors the tracking form will be completed by the Editor. External manuscripts are approved by the Editor in consultation with the Chief Geologist or appropriate manager.

Following proofing and approval by the section manager or research supervisor, **a double-spaced copy** of the typewritten manuscript, which **must include all figures, plates, tables and captions**, is submitted to the Editor, together with a copy of the files on an IBM compatible diskette. Most common word processor files are acceptable but Microsoft Word is preferable. **Incomplete manuscripts will not be accepted.** *(Note:* files generated in the Windows environment are currently not compatible with our typesetting systems – please submit material in DOS format.)

The manuscript is formatted, edited and returned to the author for approval. **The turnaround for author's approval is limited, please give the manuscript your immediate attention as soon as it is returned.** Authors wishing to discuss editorial comments should do so by telephone or FAX, or arrange to meet with the Editor.

Following approval, revisions will normally be made by staff of the Scientific Review Office - however, if extensive revisions are required the Editor will request that the author supply an updated manuscript on diskette. **Revisions to artwork are the responsibility of the author**. PMTs are prepared by the SRO from approved line drawings.

The diskette and hard copy are forwarded to the Queen's Printer for the production of galley proofs. Galley proofs are returned to the Editor for a second edit. A copy of edited galley proofs is forwarded to authors for review; normally in the two to three-week period immediately before Christmas. Authors are given a short time to return corrections but production will proceed on approval of galleys by the Editor.

Galleys are united with PMTs of illustrations and the complete package is returned to Queen's Printer for production of page proofs. Page proofs are reviewed by the Editor for errors in pagination, layout *etc.*, and approved for printing. Page proofs are not normally sent to authors for review due to time constraints in the publication process. **It is imperative therefore, that the first draft manuscript contain a copy of all original artwork and photos and that they be clearly marked with numbers and captions when they are first submitted.**

BRITISH COLUMBIA EXPLORATION AND DEVELOPMENT HIGHLIGHTS FOR 1990: GOLD AND PORPHYRY DEPOSITS CONTINUE TO EXCITE INVESTORS

By V.A. Preto
Manager, District Geology and Coal Resources

INTRODUCTION

The year 1990 was one of new and significant developments in British Columbia. It was also one of transition for junior exploration companies and prospectors, the leading mine finders in the province, as they learned to adjust to life after flow-through.

Unlike 1989, which saw some of the most frantic activity ever, the junior-dominated Vancouver Stock Exchange was adversely affected by the termination of flow-through financing and continued negative publicity, and struggled through a very rough year. Its performance during September was the worst ever recorded.

New discoveries were few as most of the exploration activity was concentrated near exciting "hot spots", such as **Eskay Creek** and **Mount Milligan**, leaving the rest of the province, and particularly the southern half, much quieter.

Exploration expenditures are anticipated to total $143 million, only slightly lower than the $150 million spent in 1989. These expenditures, however, are very unevenly distributed across the province. It is anticipated that some $60 million has been spent in the Stewart - Iskut River area, British Columbia's Golden Triangle, $29 million of this at **Eskay Creek**, which continues to be accessible only by air. Another $25 million or so has been spent in a handful of other major projects in the northwest. Expenditures of $33 million are anticipated for the northern Quesnel trough because of the **Mount Milligan** success, leaving only $25 million, or roughly 16 per cent, for

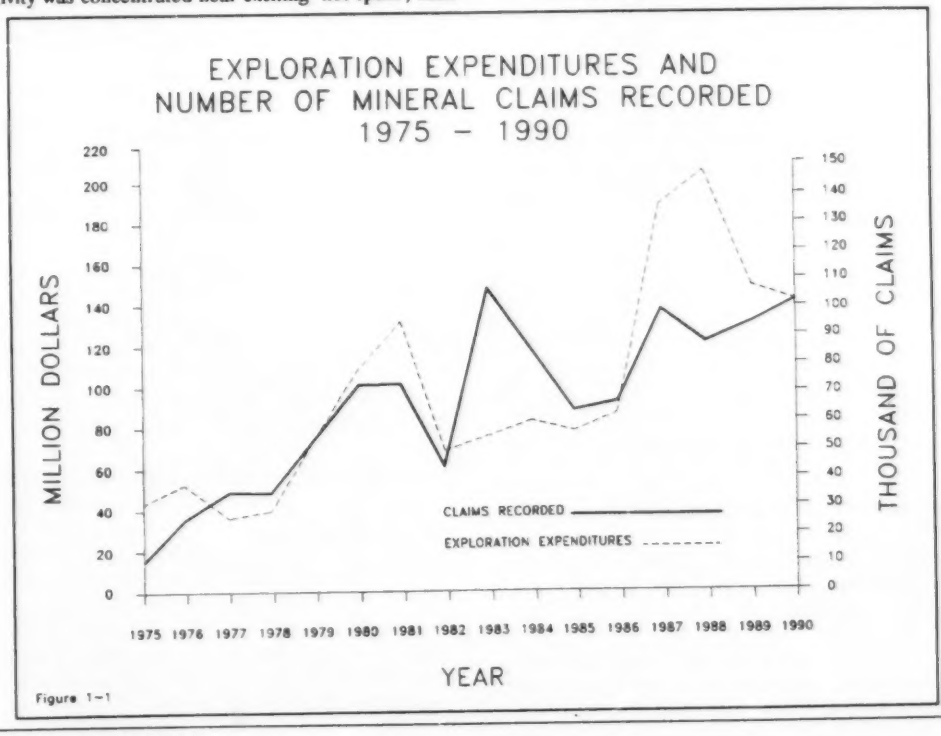

Figure 1-1

BRITISH COLUMBIA
MINERAL EXPLORATION REVIEW

Exploration Review is published annually in January and presents the Geological Survey Branch's preliminary overview of private sector exploration activity during the previous year. It contains articles and a detailed table of mineral exploration activities contributed by District Geologists. It is printed in the Information Circular series of publications for free distribution.

The emphasis of *Exploration Review* is on exploration trends and concepts rather than a blow-by-blow account of who did what and where. The brochure contains a provincial overview by the Manager, District Geology, and each District Geologist contributes a 2000 to 4000 word (3 to 5 page) summary of exploration and development in their respective districts. The statistical aspects of the report are contained in tables listing exploration and development projects and active mines, with their accompanying location maps.

Each District article should consist of the following items:

- **INTRODUCTION** - containing total exploration dollars spent, number of claims staked, new mines in operation, mines which have closed, new properties coming on stream with the exact or approximate date that start-up is expected, significant new discoveries.
- **HIGHLIGHTS** – brief and in point form; drilling, new mines, new developments *etc.*
- **TRENDS** – general industry or government policies, events *etc.* affecting exploration/mining activities.
- **OPPORTUNITIES** – new deposit models, discoveries, new demands for metals known to occur in the area.
- **RESEARCH** – review in brief, GSB mapping and research in the District. Identify GSC or University activity as well. This will be of interest in determining what potential publications and information will be forthcoming over the next few years.
- **ILLUSTRATIONS** – graphs of claim staking, exploration expenditures, notices of work, break down of dollars spent in metals-coal-industrial mineral sectors.
- **MAP** –all Districts must have a page size map showing all properties listed in Table 3. Map must have an NTS grid.

PUBLICATION FORMAT

Exploration Review is published in an 8 ½ by 11-inch two-column format. The manuscript is printed from word-processor quality camera-ready copy. Colour illustrations are not permitted. Inclusion of illustrations within individual papers is encouraged but due to the very tight publication schedule they should be kept to a minimum. **Illustrations must complement the text in a significant way**.

The format and style for the tables listing active mines and exploration properties will be as in 1990, listing property and MINFILE No., Mining Division, NTS designation, commodity, deposit type and a brief summary of work done during the year (*see* **recent issues for punctuation and abbreviations**). The criterion for inclusion of a property in the tables is that significant exploration work has been done, *e.g.*, drilling, trenching, or development work. It is not the intention to report on every exploration project in the province. Properties listed are by district and alphabetically by property name, but **it is not required that every listing be mentioned in the text**.

DEADLINES

Exploration Review is produced concurrently with *Geological Fieldwork* and is subject to the same tight publication schedule. It is essential that all deadlines be strictly adhered to. **The latest deadline for submission of typed manuscripts and diskettes to the Editor is the last working Friday before Christmas (Dec. 25)**, but, it would be greatly appreciated if all the Xmas Grinches could submit material early!

PUBLICATION PROCEDURES

Procedures for publication of *Exploration Review* are essentially the same as those for Open File reports.

Manuscripts are approved by the Manager before submission to the Editor. Authors must input manuscripts on a word processor. Hard copies must be submitted accompanied by digital files on diskette. All final captions, tables and illustrations must be submitted with the first draft.

The manuscript is edited and returned to the author for approval. **The turnaround time for author's approval is limited, please give the manuscript your immediate attention as soon as it is returned to you.** The majority of authors are not Victoria-based and should therefore be prepared to discuss suggested revisions with the Editor by FAX or telephone. The production schedule does not allow sufficient time for manuscripts to move back and forth between Editor and author through the mail.

Following editing, the typed manuscript, including tables, is corrected and formatted by staff of the Scientific Review Office. **Corrections arising from proofing of the first draft will be made at this stage**. Approved line

drawings are forwarded for preparation of PMTs.

Every effort will be made to provide authors with a hard copy of the revised text for final checking, however, **it will not be possible to delay the production process pending approval from authors.**

The updated manuscript is proofed and paginated by the Editor and camera-ready copy forwarded to the Queen's Printer no later than January 15.

EXPLORATION IN BRITISH COLUMBIA

Exploration in British Columbia is published annually in mid-summer. **It is the Geological Survey Branch's report on private sector exploration activity during the previous year and the results of original research in economic geology. It is intended as a permanent record of important exploration developments in the province.**

The publication is divided into two parts: Part A is an overview of exploration activity, organized on a district-by-district basis and consisting largely of articles contributed by District Geologists; Part B contains descriptions of individual properties, mining districts or active exploration areas and research reports on topics concerning economic geology.

PUBLICATION FORMAT

Exploration in B.C. is published in 8 1/2 by 11-inch in two-column format. The manuscript is printed from camera-ready copy typeset and formatted in the SRO. Inclusion of illustrations is encouraged, but they must complement the text in a significant way and the use of colour is not permitted. Line drawings are not professionally drafted; line work is the responsibility of authors.

PART A

Articles for inclusion in Part A deal with the exploration trends and highlights in the province, on a district-by-district basis, The substance is expanded from the *Exploration Review* summary and the content will reflect a more detailed review of activities for the full 12-month calendar period. Revised versions of the tables and location maps published in *Exploration Review* will be included. The style and format of the tables, and the criteria for inclusion of a property, are the same as for the Review (refer to procedures for *British Columbia Mineral Exploration Review*).

PART B

Part B consists of articles and short reports that contain new or updated geological information relating to research in economic geology, specific properties, active exploration areas and topics of interest regarding mineral exploration and development. All Geological Survey Branch scientists, including contract staff, are encouraged to contribute.

Economic geology manuscripts from industry and academia are welcomed, particularly where they are joint efforts with GSB staff.

Reports may range from 1000 to 10 000 words (about 1 to 20 pages with illustrative material) and deal with metallic mineral, coal or industrial mineral properties which were mapped or visited by the author, or for which a geological update can be provided. Meaningful illustrations are encouraged.

Authors are encouraged to deal with groups of properties or small districts and to preface individual property reports with a brief introduction covering the geology of the area and providing a framework for comparing or contrasting specific aspects of the descriptions that follow. This will provide an opportunity to develop concepts and offer suggestions or recommendations to the reader, perhaps drawing attention to properties which are not under active investigation but deserve attention.

Part B may also contain articles of broad economic interest, including metallogenic studies, exploration techniques, deposit model descriptions or other material related to economic geology studies.

DEADLINES

The deadline for submission of typewritten manuscripts to the Editor is usually April 1 but this will be confirmed on an annual basis by a memo from the Editor to each of the Section Managers and all District Geologists.

ESKAY CREEK (104B 008)

(Fig. B1, No. 14)

By J.M. Britton, J.D. Blackwell[1] and T.G. Schroeter

LOCATION: Lat. 56°38' Long. 130°27' (104B/9W)
SKEENA MINING DIVISION. The property is located 84 kilometres north-northwest of Stewart and 4 kilometres east of Tom Mackay Lake on the Prout Plateau between the Unuk and Iskut rivers.

CLAIMS: TOK 1-22, KAY 11-18.

ACCESS: By fixed-wing aircraft to gravel strips at Bronson Creek or Johnny Mountain and thence by helicopter to the property, or by helicopter from bases at Bell-Irving River or Bob Quinn Lake on Highway 37.

OWNERS: Stikine Resources Limited and Prime Resources Group Incorporated.

OPERATOR: PRIME EXPLORATIONS LIMITED.

COMMODITIES: Gold, silver, zinc, lead, copper, arsenic, antimony, mercury.

#21 ZONE DEPOSITS, ESKAY CREEK, NORTHWESTERN BRITISH COLUMBIA

SUMMARY

Exploration in northwestern British Columbia has received international attention as a result of the #21 zone gold, silver and base metal discoveries at Eskay Creek, 80 kilometres north of Stewart. Geological reserves total 5 023 000 tonnes grading 15.6 grams per tonne gold and 441 grams per tonne silver at a cut-off grade of 1.4 grams per tonne gold. Included in this is a high-grade core of 1 223 000 tonnes averaging 49.4 grams per tonne gold, 1392 grams per tonne silver, 5.5 per cent zinc and 2.2 per cent lead.

The discovery area lies within a well-known belt of base and precious metal showings that has been explored intermittently since the 1930s. These prospects are contained in felsic volcanic rocks near the top of the Lower to Middle Jurassic Hazelton Group. Hostrock stratigraphy is: a lower sequence of interbedded dacitic tuffs and wackes; a middle sequence of rhyolitic tuffs and breccias; and an upper sequence of andesitic pillow breccias and flows, intercalated with mudstones.

The recent discoveries result from drill-testing the subsurface extensions of an old prospect, the #21 open cut, a low-grade, base and precious-metal stockwork that occurs in the rhyolite sequence. Drilling has traced exceptionally high-grade gold and silver-bearing sulphide mineralization more than 1400 metres along strike and 250 metres down dip.

Two deposits, the 21A and 21B, have so far been delineated. Both comprise stratabound massive sulphide lenses within a tuffaceous mudstone unit at the rhyolite-andesite contact. Disseminated and stockwork mineralization is also present in immediately underlying rhyolite. The northern part of the 21B deposit has two massive sulphide lenses within interflow mudstones of the upper sequence. The deposits have distinctively different mineralogies. The 21A is rich in stibnite and realgar with only minor pyrite and base metal sulphides. The 21B lacks stibnite and realgar but contains abundant sphalerite, tetrahedrite, boulangerite, bournonite, galena and pyrite.

Current work includes definition drilling and development of the 21B deposit as well as outlining additional discoveries such as the 21C and Pumphouse zones.

The Eskay Creek project is an exploration and development joint venture between Prime Resources Group Incorporated and Stikine Resources Limited, with Prime Explorations Limited as project operator.

INTRODUCTION

This report describes the geology and mineral deposits of Eskay Creek highlighting the exciting discoveries made since September, 1988. It is necessarily a snapshot since aggressive exploration continues to bring fresh facts to light.

It is also a collaborative paper with contributions as follows: regional and property geology (JMB) are based on reconnaissance mapping conducted in the Iskut-Sulphurets gold belt since 1987 and property visits in July and August, 1989. Property history, stratigraphy and mineralization (JDB) stem from an association with the project since December, 1988. Photography, deposit sampling and geology (TGS) come from a property visit in September, 1989.

1 Consulting geologist to Prime Explorations Limited.

METALLOGENIC STUDIES IN SOUTH-CENTRAL BRITISH COLUMBIA: MINERAL OCCURRENCES IN THE NICOLA LAKE REGION (92I/SE)

(Fig. B1, No. 6)

By R.E. Meyers, J.M. Moore, T.B. Hubner and A.R. Pettipas

INTRODUCTION

The Nicola Lake region has a long and varied history of mineral resource exploitation. The area is dominated by the Nicola volcano-sedimentary belt which, throughout its length in the Intermontane Belt of British Columbia, is known for its relationship to several major porphyry copper-gold and copper-molybdenum producers. However, despite the base metal mining history in adjacent regions, the prime exploration focus in the Nicola Lake area has been on precious metals targets. The known mineral occurrences vary from quartz and quartz-carbonate veins to base metal bearing and, to a lesser extent, precious metal bearing skarns; porphyry mineralization, so important elsewhere in the region, is generally under-represented.

This report consolidates data collected and compiled on the mineral occurrences in the Nicola Lake area in 1988 and 1989 during limited mapping programs (Moore, 1989) associated with the LITHOPROBE transect and subsequently to compile the geology of the 92I/SE map sheet (Moore and Pettipas, 1990). The regional geology, as described here, is modified from Moore *et al.* (1990).

HISTORY

In the 1890s prospectors working around Mineral Hill, near Stump Lake, discovered gold-silver-bearing quartz veins, which would later become the Joshua, Tubal Cain, Enterprise and King William properties. During early development of the prospects the area was described as "...a new and enormously rich mining district...", having geology "...similar to that of the richest mining districts in Mexico..." (Dodd, 1887, p. 274). Encouraging statements such as this attracted numerous prospectors and geologists to the region and eventually mining companies were formed to develop the newly discovered mineral deposits.

During this period, and well into the 1920s, promising-looking discoveries were made at Iron Mountain, near Merritt, Nicola Lake and Swakum Mountain. Most were gold-silver-bearing quartz veins, containing variable amounts of lead, zinc and copper; at some localities barite, tungsten and molybdenum were also found.

Stump Lake saw the first significant mine and mill development on the Enterprise and King William veins. This mine produced some 70 000 tonnes of gold-silver-lead-zinc-copper ore during intermittent operating periods between 1916 and 1942.

At Swakum Mountain the first discovery was the Lucky Mike copper-gold skarn in 1916, followed by the Old Alameda in 1920 and the Thelma/Bernice in 1927. The latter were polymetallic mesothermal to epithermal veins, from which only minor production came, amounting to about 80 tonnes of lead-zinc-silver-gold ore. In 1943, the Strategic Minerals Committee evaluated the Lucky Mike deposit for its tungsten potential, estimating a grade of 0.312 per cent WO_3.

By 1929, the Leadville/Comstock shaft was developed on Iron Mountain, with minor barite-rich lead-zinc-silver production. Small exploration shafts had already been sunk on the Charmer prospects, but without much success.

North of Nicola Lake, the Turlight (Copperado) copper-gold deposit was discovered and developed during 1928-29. Following several periods of exploration and construction, the property produced about 227 tonnes of 5 per cent copper ore by 1960.

During the 1950s, stimulated by activities and discoveries in the Highland Valley to the northwest, the Promontory Hills area, on the southern edge of the Guichon Creek batholith, became the focus of exploration. The initial approach was to follow-up magnetic lows (using a Highland Valley model); this strategy later changed when magnetite-copper skarn mineralization was recognized. Craigmont was discovered in 1957, and until 1982, a total of 29 325 342 tonnes were mined, averaging 1.37 per cent copper, 0.37 per cent iron, 0.0023 gram per tonnne gold and 0.0071 gram per tonne silver.

Despite a long and intermittently aggressive history of exploration, only the Craigmont deposit became a major producing mine. However, more than 200 known mineral occurrences have been discovered in this relatively small region, only a portion of which are shown on Figure B-6-2, 3 and the prospects for new discoveries continue to be high.

GEOLOGICAL SETTING

The geology of the Nicola Lake region (Figure B-6-1) was first mapped at 1:253 440-scale by Cockfield (1948), who summarized earlier studies and reported in detail on many small mines and mineral occurrences. More

TABLE A-2
MINE DEVELOPMENT REVIEW PROCESS (MDRP)
PROJECTS IN REVIEW, DECEMBER 1990

PROSPECTUS

PROJECT/COMPANY DEVELOPMENT REGION	COMMODITY/PRODUCTION RATE*/MINE LIFE	EMPLOYMENT (CONSTRUCTION/ OPERATION)/COMMUNITY	DEVELOPMENT SCHEDULE (STAGE/AIP**/PRODUCTION)
Harmer West Extension/ Westar Coal Kootenay	10 seam coal 4.8 million tpy	Existing employment Sparwood	Prospectus - Oct 1990 Review by Kootenay Mine Development Review Committee
Silbeck Premier SB Zone/ Westmin Resources Ltd. North Coast	Au, Ag 100 000 t total for 1 yr Feed for existing mill	Existing employment Stewart	Prospectus - Dec 1990 Review by Northwest Mine Development Review Committee
Sukunka/Canadian Coal Co. Inc. Northeast	Underground metallurgical coal 2.2 million tpy for 20 yrs	Constr: 175 Op: 239 Tumbler Ridge, Chetwynd, Dawson Creek	Prospectus - May 1990 Review on-going
Vine Property/Kokanee Explorations Ltd. Kootenay	Bulk sample 200 st Metallurgical testing	Cranbrook	Prospectus - Nov 1990 Review by Kootenay Mine Development Review Committee

STAGE I (OR EQUIVALENT)

PROJECT/COMPANY DEVELOPMENT REGION	COMMODITY/PRODUCTION RATE*/MINE LIFE	EMPLOYMENT (CONSTRUCTION/ OPERATION)/COMMUNITY	DEVELOPMENT SCHEDULE (STAGE/AIP**/PRODUCTION)
Byron Creek South Mine Extension/Byron Creek Collieries Kootenay	Thermal coal	Existing employment	Stage I - Nov 1990 Sparwood
Cirque/Curragh Resources Inc. Northeast	Pb, Zn, Ag 3500 tpd for 16+ yrs	Constr: 200 Op: 250 Fort St. John, Mackenzie, Prince George	Stage I - Spring 1991
Crystal Peak/Polestar Exploration Inc. Thompson-Okanagan	Garnet 100 – 200 stpd for 20 yrs	Total: To be determined Apex Village, Penticton	Stage I - Winter 1991
Equinox (J & L)/Equinox Resources Ltd., Pan American Minerals Corp.	Au, Ag, Pb, Zn 350 mtpd for 10 yrs	Constr: 50 person yrs Op: 80 – 90 Revelstoke	Stage I - 1991
Eskay Creek/ Corona Corp. North Coast	Au, Ag 750 – 1500 stpd for 10-12 yrs	Constr: 200 – 300 Op: 200 – 250 Smithers, Stewart, Terrace	Prospectus - April 1990 Stage I - March 1991
Golden Crown/ Attwood Gold Corp. Kootenay	Au, Cu 200 stpd for 2 yrs	Op: 20 – 30 Grand Forks	Stage I - 1990
Henretta Dragline/ Fording Coal Ltd. Kootenay	Metallurgical and thermal coal Existing production	Existing employment Elkford	Prospectus - March 1990 Stage I - Dec 1990

TABLE A-3
ACTIVE EXPLORATION PROPERTIES IN BRITISH COLUMBIA, 1990

Property (Operator)	MINFILE Number	Mining Division	NTS	Commodity	Deposit Type	Work Done
Northwestern Distict						
4J's (Orequest Consultants Ltd.)	104B 128	Skeena	104B/8E	Zn, Pb, Ag, Au		5 ddh, 405 m; geochem; mapping
Albino Lake (Eurus Resource Corp.)		Skeena	104B/9W	Au		Initiating 8-10 ddh totaling 2500 m
Atlin Ruffner/Mount Vaughan (Homestake Mineral Dev. Co.)	104N 011	Atlin	104N/11W, 12E	Ag, Pb, Zn	Vein	15 ddh, 1188 m
Axe (Ascot) (Ascot Res. Ltd.)		Liard	104G/9,16	Au, Ag, Cu	Porphyry	1 ddh, 151 m; geochem; geophys
Axe (Beauchamp) (Ascot Res. Ltd.)		Liard	104G/9E	Au, Ag, Cu	Vein	3 ddh, 268 m; geophys; geochem
B1-North (Kestrel Res. Ltd.)		Liard	104B/15	Au		2 ddh, 340 m
Ball Creek (Placer Dome Explr. Inc.)	104G 042	Liard	104G/8W	Ag, Au, Cu	Vein	4 ddh, 330 m
Bar (Goldbank Ventures Inc.)		Atlin	114P/15W	Au, Cu, Pb, Zn	VMS	12 ddh, 1134 m; geophys; trenching; geochem
Bell Mine (Noranda Minerals Inc.)	093M 001	Omineca	093M/1E	Cu, Au, Ag	Porphyry	82 ddh, 20 919 m
Bob Creek (Equity Silver Mines Ltd.)	093L 005	Omineca	093L/7E	Au, Ag, Zn	Transitional	5 ddh, 988 m
Cam 5,6 (Crimsonstar Res. Ltd.)	104B 328	Liard	104B/10W	Au, Ag		4 ddh
Cheni Gold Mine/Lawyers (Cheni Gold Mines Inc.)	094E 066	Omineca	094E/8E	Au, Ag	Epithermal vein	74 ddh, stc, u/g, 14 846 m; geophys, geochem; 2440 m drifting
Copper Canyon (Cons. Rhodes Res. Ltd.)	104G 017	Liard	104G/3W	Cu, Ag, Au	Porphyry	13 ddh
Coulter Creek (Swift Minerals Ltd.)		Skeena	104B/9,10	Au, Ag		5 ddh, 762 m
Dauntless (Westmin Res. Ltd.)		Skeena	104B/1E	Ag, Au	Vein	1 ddh, 412 m
Deer Horn Mine/Lindquist (Teck Explr. Ltd.)	093E 019	Omineca	093E/6W	Au, Ag, Cu, W	Vein	29 ddh, 2268 m
Del Norte (Orequest Consultants Ltd.)		Skeena	104A/4E,3W	Au, Ag, Cu, Pb, Zn	Vein	12 ddh, 3669 m; trenching; geochem; geophys; mapping
Dome Mountain (Teeshin Res. Ltd.)	093L 022	Omineca	093L/10E, 15E	Au, Ag, Pb, Zn	Vein	18 ddh, 2326 m
Equity Silver Mine (Equity Silver Mines Ltd.)	093L 001	Omineca	093L/1W	Ag, Au, Cu	Transitional	3 ddh, 1088 m
Eric (Equity Silver Mines Ltd.)		Omineca	093L/2E	Cu, Ag, Au	Stratabound	7 ddh, 1077 m; geophys; geochem
Erickson (Erickson Gold Mining Corp.)	104P 029	Liard	104P/4E,5E	Au	Mesothermal vein	43 ddh, 7941 m; geophys
Eskay Creek/Tok-Kay (Corona Corp./Prime Explr. Ltd.)	104B 008	Skeena	104B/9W	Au, Ag	VMS	485 ddh, 98 000 m; 1000 m drifting; bulk sample; geophys; mapping
Foremore (Cominco Ltd.)		Liard	104G/2W	Au, Pb, Zn	Massive sulphide?	5 ddh, 1349 m; geophys; mapping
Forrest Kerr (Pamicon Dev. Ltd.)		Liard	104B/15E	Au, Ag, Cu		24 ddh, 2500 m
Gab 9 (Pamicon Dev. Ltd.)		Liard	104B/10W	Au		5 ddh, 2523 m
Gab-Mon/Seagold (Kestrel Res. Ltd.)	104B 335	Liard	104B/15	Au, Ag, Zn	Vein	7 ddh, 840 m; air and grd geophys; geochem; mapping; trenching
Galore Creek/Stikine Copper (Mingold Res. Inc.)	104G 090	Liard	104G/3W,4E	Cu, Au, Ag	Porphyry	18 ddh, 1925 m
Georgia River (Bond Gold Canada Inc.)	103O 013	Skeena	103O/16W	Au, Ag, Pb, Zn, Cu	Vein	drilling
GJ (Ascot Res. Ltd.)		Liard	104G/9E	Cu, Au	Porphyry	9 ddh, 1858 m; geochem; geophys
GHC (Prime Equities Inc.)		Skeena	104B/9W	Au, Ag, Pb, Zn		19 ddh, 3028 m; geophys; geochem; mapping

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The manuscript is edited and returned to the author for updating. The Editor will discuss suggested changes at the author's request.

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APPENDIX III
Guidelines for Preparing Field Trip Guidebooks

Guidelines for Authors, Editors and Publishers of Geologic Field Trip Guidebooks

This material has been prepared by the guidebooks standards committee, 1990. Clarion Kidd (U Oklahoma) chair, Dorothy McGarry (UCLA), and Rosalind Walcott (SUNNY-Stony Brook).

Field trip guidebooks make a significant contribution to geoscience literature. Guidebooks are often the most current or the only synopsis of an area's geology, and therefore, are essential reading for researchers and students. Casual references to guide books often include only the name of the society or meeting associated with the guidebook. A complete guidebook title page should contain specific key information to help identify, acquire, and make available geologic field trip guidebooks.

These concerns led the Geoscience Information Society (GIS) to begin a compilation of its *Union List of Geologic Field Trip Guidebooks of North America*, now in its fifth edition. Continued problems of identification have prompted the GIS to formulate the following guidelines for authors, editors, and publishers. You can contribute significantly to the identification and control of the guidebook literature by applying these recommendations to any published guidebooks for which you have editorial or compilation responsibility.

The TITLE PAGE should include:

- A title identical to that on the cover.
- A clearly indicated subtitle, if there is one.
- Date(s) of the field trip, preferably near the title of the guidebook.
- Specific geographic area as part of a descriptive title (*e.g.* country, province and NTS map sheet).
- Meeting place when the field trip is held in conjunction with a meeting. If it is a regular annual meeting, with several field trips, specify the number of the annual meeting and each field-trip number.
- Name of the sponsoring organization(s).
- If issued as volumes of a set, each volume should be identified with the same set name. for example, all 15 guidebooks from the *1979 International Congress of Carboniferous Stratigraphy and Geology* should have this exact name repeated on the title and cover of each guidebook. Include the volume title and its number.
- Name of the field-trip leader and editor. Indicate the responsibility of each person.
- For reprints, indicate title, series title, guidebook number and the year of publication of the original.

On the BACK of the title page:

- Cataloguing in Publication information. This can be arranged through the Editor and the Legislative Library.
- Name and address of the publisher, if not on the title page, and the distributor, if different from the publisher.
- Price of the publication.

General Recommendations:

Publications:

- Use good quality paper, printing, and binding (preferably, not spiral binding because it disintegrates under heavy use). If spiral bound, provide a gutter margin of one inch for archive binding.
- Number pages consecutively.
- Identify all illustrations and maps.
- Identify the guidebook on the first page of every article. This insures that reprints of single articles can be properly referenced.
- List all unbound illustrative material in a table at the front of the volume, and include a pocket to hold all these pieces in the back of the publication.

Distribution:

- Print more copies of the guidebook than are needed for field-trip participants. Remember, this is a contribution to the literature of geology. Your potential market may be several hundred libraries holding geological collections.
- The B.C. Geological Survey Branch maintains a distribution arrangement with a number of federal, provincial and state libraries (~55). Contact the Editor to arrange for distribution. **Six copies must be deposited with the B.C. legislative library if the guide is a Ministry publication.**
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Sample Publications Forms

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	Paper	☐	**Preliminary Map** ☐
Open File (Report)		☐	**Open File (Map)** ☐
Geological Fieldwork		☐	**Exploration in BC** ☐
External Journal		☐	**Geoscience Map** ☐

Other (specify): _____

Estimated Size of Publication *Small < 50 pp* ☐ *Medium 50 -> 150 pp* ☐ *Large > 150 pp* ☐

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Author: _____ Date: _____
Editor: _____ Date: _____

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(Complete typewritten manuscript & illustrations received by Editor)

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NOTES

Geological Time - Symbols & Usage

Cenozoic	C	Paleozoic	P
Quaternary	Q	Permian	P
Holocene/Recent	R	Carboniferous	C
Pleistocene	P	Pennsylvanian	P
Tertiary	T	Mississippian	M
Neogene	N	Devonian	D
Pliocene	P	Silurian	S
Miocene	M	Ordovician	O
Paleogene	P	Cambrian	Є
Oligocene	O	Proterozoic	PH
Eocene	E	Hadrynian	H
Paleocene	P	Helikian	H
Mesozoic	M	Aphebian	A
Cretaceous	K	Archean	A
Jurassic	J		
Triassic	T		

MODIFIERS

The following modifiers are placed on the left side of the age symbol:

Early - E *Middle* - M *Late* - L
lower - l *middle* - m *upper* - u

e.g. LATE TRIASSIC - LT

Small capital letters designating Group, Formation or Member are placed on the right side of the age symbol:
e.g. JURASSIC NELLS CREEK FORMATION - JNC

Lower case letters designate lithology and/or mineralogy:
e.g. CRETACEOUS granite - Kg

Hyphens are used to separate Group, Formation and member symbols:
e.g. Devonian Carbon Formation lower member - DCF-l

Information Circular 1992-7

GEOLOGIC TIME SCALE - BRITISH COLUMBIA GEOLOGICAL SURVEY BRANCH

Phanerozoic data derived from:
1) W.B.Harland et al. (1990)
PreCambrian data from:
1) Lumbers & Card (Geology, Vol. 20 1991)

PHANEROZOIC

CENOZOIC

PERIOD	EPOCH / STAGE		Ma Age
QUATERNARY	Holocene		0.01
	Pleistocene	Calabrian	1.64
NEOGENE	PLIOCENE L	Piacenzian	3.40±1.35
	PLIOCENE E	Zanclian	5.2 ± 1.5
	MIOCENE L	Messinian	6.7 ± 2.3
		Tortonian	10.4 ± 1.5
	MIOCENE M	Serravallian	14.2 ± 1.8
		Langhian	16.3 ± 1
	MIOCENE E	Burdigalian	21.5 ± 1.8
		Aquitanian	23.3 ± 1
PALEOGENE	OLIGOCENE L	Chattian	29.3 ± 1.5
	OLIGOCENE E	Rupelian	35.4 ± 1.4
	EOCENE L	Priabonian	38.6 ± 1.5
	EOCENE M	Bartonian	42.1 ± 1.8
		Lutetian	50 ± 1.5
	EOCENE E	Ypresian	56.5 ± 1.4
	PALEOCENE L	Thanetian	60.5 ± 2.3
	PALEOCENE E	Danian	65 ± 2

MESOZOIC

PERIOD	EPOCH / STAGE		Ma Age
CRETACEOUS	Late	Maastrichtian	65.0 ± 2
		Campanian	74.0 ± 3
		Santonian	83 ± 4
		Coniacian	86.6 ± 3
		Turonian	88.5 ± 2
		Cenomanian	90.4 ± 2
	Early	Albian	97.0 ± 2
		Aptian	112 ± 2
		Barremian	124.5 ± 1.3
		Hauterivian	131.8 ± 8
		Valanginian	135.0 ± 8
		Berriasian	140.7 ± 1.3
JURASSIC	Late	Tithonian	145.6 ± 9.5
		Kimmeridgian	152.1 ± 11.5
		Oxfordian	154.7 ± 6.5
	Middle	Callovian	157.1 ± 8
		Bathonian	161.3 ± 7
		Bajocian	166.1 ± 7
		Aalenian	173.5 ±11.5
	Early	Toarcian	178 ±11
		Pliensbachian	187 ± 15
		Sinemurian	194.5 ± 5
		Hettangian	203.5 ± 6.5
TRIASSIC	Late	Norian	208 ± 7.5
		Carnian	223.4 ± 9.5
	Middle	Ladinian	235 ± 4
		Anisian	239.5 ± 6.5
	Early	Spathian	241.1 ± 8
		Smithian	(242)
		Dienerian	(243)
		Griesbachian	(244) 245 ± 9.5

PALEOZOIC

PERIOD	EPOCH / STAGE		Ma Age
PERMIAN	Late	Changhsingian	245 ± 9.5
		Dzhulfian	247.5 ± 11
		Capitanian	250 ± 12
		Wordian	252.5 ± 13
		Roadian	255 ± 12
	Early	Artinskian	260 ± 11
		Sakmarian	269 ± 11
		Asselian	281.5 ± 13
CARBONIFEROUS PENNSYLVANIAN	Late	Gzhelian	290 ± 9
		Kasimovian	295 ± 6.5
		Moscovian	303 ± 5
		Bashkirian	311.5 ± 9.5
CARBONIFEROUS MISSISSIPPIAN	Early	Serpukhovian	323 ± 9
		Visean	333 ± 8
		Tournaisian	349.5 ± 4.5
DEVONIAN	Late	Famennian	362.5 ± 5.5
		Frasnian	367 ± 5
	Middle	Givetian	377.5 ± 10
		Eifelian	
	Early	Emsian	381 ± 11
		Siegenian/Pragian	386 ± 5.3
		Gedinnian/Lochkovian	390.5 ± 12
SILURIAN	Late	Pridolian	396.3 ± 11
		Ludlovian	408.5 ± 4.5
	Early	Wenlockian	411 ± 4
		Llandoverian	424 ± 4
ORDOVICIAN	Late	Gamachian	430.4 ± 9
		Richmondian	(445)
		Maysvillian	(452)
		Edenian	(458)
	Middle	Trentonian	464 ± 7.5
		Blackriverian	(467)
		Chazyan	(470)
		Whiterockian	(473) 476 ± 7.5
	Early	Canadian	
CAMBRIAN	Late	Trempealeauan	510 ± 9.5
		Franconian	(512)
		Dresbachian	(515) 517.2 ± 17
	Middle		536 ± 5.5
	Early	Waucoban	(553)
		Placentian	570 ± 15

EON

PROTEROZOIC

ARCHEAN

PRECAMBRIAN

ERA		PERIOD	Ma Age
Hadrynian (late)	Neoproterozoic	Neoproterozoic III	570
		Cryogenian	650
		Tonian	850
Helikian (middle)	Mesoproterozoic	Stenian	1000
		Ectasian	1200
		Calymmian	1400
Aphebian (early)	Paleoproterozoic	Statherian	1600
		Orosirian	1800
		Rhyacian	2050
		Siderian	2300
			2500
Neoarchaean (late)			
Mesoarchaean (middle)			2800
Paleoarchaean (early)			3200
Eoarchaean (earliest)			3600
		base not defined	

208 ± 18 isotopic age for stage boundary & uncertainty; (239) interpolated isotopic age for stage boundary